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CONTENTS.

Editorial 93
The Philadelphia Electric Trust 95
Strike at the Westinghouse Works 95
The New Photography 95
Relative Cost of Gas and Electricity 95
Magnetic Properties of Iron and Steel, by J. A. Kingdon 96
Central-Station Working—IV., by George I. Thayer 97
The Up-Building of a Small Town, by Fred. DeLand 98
Government Engineering Laboratories 98
The Niagara Street Railway Transformer Plant 99
Suburban Electric Railways at Cleveland 99
Milwaukee Convention of the Northwestern Electrical Association 100
Storage Batteries in Central Stations, by Maurice Barnett 101
Central-Station Economy, by W. J. Buckley 102
Arnold Electric Power-Station System 103
The Invention of the Electromagnetic Telegraph 104
Electrical Warfare 105
The Laval Steam Turbine, by W. F. M. Goss 105
Storage Batteries for Telephonic Service, by Charles Blizard 105
A Medical Oscillator 105
Digest of Current Technical Electrical Literature, Compiled by Carl Hering 106
New Book 110
A New Safety Device for Steam Engines 110
Dynamo and Combined Volt and Ampere Meter 111
Departments:
Special Correspondence 112
General News of the Week 114
Trade and Industrial Notes 114
Business Notices 115
Illustrated Record of Electrical Patents 115

FORCED DRAFT.

In the growing central or power station the question of increased boiler capacity is frequently a most troublesome one to deal with on account of limitations of space; and where the load line is particularly peaked the solution of putting in more boiler-power merely to carry the peak for a few hours is far from a satisfactory one, not only on account of the capital outlay and space occupied, but also because of the all-day decrease in economy of steam generation entailed. The best solution, in most cases, is afforded by the storage battery, but a cheaper method consists of installing a fan and providing for forced draft. While with any air pressure increasing the capacity of the boiler plant to any significant extent, there is a loss of efficiency in generating steam, yet as this would extend over but a comparatively short period, the resultant efficiency may be greater than with natural draft and part of the boiler plant cut out during some hours. On the other hand, the effect of forced draft on the life of boilers must be considered, and this is a point that it would be well for boiler makers to investigate. In a recent instance in Philadelphia, the boilers of one of the best-known manufacturers in the country were condemned by the users and payment refused, but upon trial in court it was shown that a forced draft of no less than four inches of water pressure was used, which pressure even torpedo boat boilers built specially for forced draft could not withstand more than a few hours, if at all. At present there seems to be no definite opinion in regard to the maximum air pressure that can with safety be used with various types of land boilers. With large marine boilers pressures of an inch and one half or more are found to produce rapid deterioration, and with two and one half inches the temperature in a furnace of such a boiler produces a glare which recalls the intensity of the arc light. With the roomy furnaces of land boilers doubtless a greater air pressure can be safely carried than with marine boilers not expressly constructed for strong forced draft, but it is extremely desirable to know just where the limit lies, as well as the increase in capacity with various pressures of draft. In the absence of such knowledge, boiler makers should be chary of issuing guarantees or staking their reputation when they know that the purchaser will use forced draft, and superintendents of central stations thinking of putting in a blower to assist the boilers over a peak in the load line, should carefully consider the subject of the amount of pressure to use.

CONVENTION OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The convention of the Northwestern Electrical Association, at Milwaukee, last week, maintained the reputation of that body as being second only to the National Electric Light Association in importance. Owing to the numerous mistakes that had occurred in the report of the proceedings of the previous year, which were made the subject of severe criticism at the opening business meeting, the secretary was instructed to submit to the speakers addressing the convention their remarks for correction before giving the stenographers' report to the press, which accounts for the absence from our columns of our usual detailed account of the proceedings, the only papers represented being those which the authors had prepared in advance of the meeting. Of these latter, that describing the Arnold central-station system, at Fort Dodge, Ia., is of particular interest from the claims made as to the advantages which that system includes, and which, the superintendent of the station states, have been fully realized in the station forming the subject of the paper. As will

be seen, the system consists of such a combination of clutches and hollow shafts running concentric with the main engine shaft that a great flexibility of connections results, combining the advantages of a direct-connected or direct-belted plant, with the range in speed of large engine-belted plants. The system would seem to be particularly applicable to the many plants where the conditions necessitate considerable variety in the types and sizes of machines. While the advantages of storage batteries for auxiliary service in central stations have been recently repeatedly pointed out in detail, yet the paper of Mr. Barnett on that subject will be welcome, particularly as it lays down the principles concerned without the usual accompaniment of considerations which, though valuable enough in themselves, are of no particular interest to the central-station man who is only interested in the points that directly apply to actual central-station conditions. The recapitulation of the paper so clearly presents the case of the storage battery for central-station use that we repeat it here: "Storage batteries are valuable in central stations on account of the threefold function they perform as reservoirs of energy, regulators of pressure and transformers of high to low or low to high tension currents. In performing these functions they make possible lower first cost in the main central-station and lower first cost for conductors between this and the sub-stations where batteries may be installed. They are further valuable in saving the power and generating machinery from strain, and in effecting economy by introducing the factor of high efficiency in the station end of the line." The paper of Mr. Buckley contains some commercial data of interest, but some of the advice given in regard to the design of plants appears to be too general in character. The conditions, with respect to the amount of money available, the price of fuel, the character of the load, the situation of the station with respect to water and centre of distribution, and still other considerations, render it difficult for any general criteria to be laid down. The safest way in every case is to secure the services of a competent engineer and follow his advice, based upon the actual conditions of the specific case. It is to be sincerely hoped that there are not many alternating plants in the United States, where, with a 77 per cent. load, there is a 33 per cent. loss of current in the line and transformers, as in the case cited by Mr. Buckley, or that such grounds as noted are permitted to exist on 1000-volt circuits. It is quite probable that the owners of such stations were not guided by engineers when the plants were installed, and very likely are of the class that put "common sense," so-called, ahead of engineering considerations in operation.

RESISTANCE OF CONDUCTORS WITH ALTERNATING CURRENTS.

In the current number of the *Bulletin* of the Société Internationale des Electricians, Mascart deduces some very simple formulas for the calculation of the increase of the ohmic resistance of conductors when traversed by alternating currents. It is well-known that the ohmic resistance offered by a conductor is apparently greater for alternating than for continuous currents. If we conceive an alternating current to be made up of an infinite number of filamentary currents, it can readily be seen that the inductive effect of the various component currents is greater on those nearest the centre, with the result that the inductive back E. M. F. is greater near the centre than near the circumference of the conductor. Consequently, the current will be unequally distributed in the section of the conductor, being more dense at the circumference, and the $C^2 R$ loss will therefore be greater than with a continuous current; if, however, the current is considered of the same density, which assumption is involved in its measurement, we may assume that the actual ohmic resistance of the conductor is increased for alternating currents, and this is the explanation usually offered. With commercial frequencies this increase of resistance is negligible except for extremely large conductors, with which, however, it assumes large proportions. With a frequency of 80, for example, the increase is but one tenth of 1 per cent. for a No. 00 copper wire, but for a copper rod 1¼ inches in diameter the increase is over 30 per cent. This large percentage can be reduced by using a tube having the same area as the rod, and becomes less as the diameter of the tube becomes greater, as is apparent from the explanation above given. Very curiously, it happens that the increase of resistance is less in an iron than a copper conductor, so that there is always a frequency at which the ohmic resistance of an iron conductor becomes equal to that of a copper one of the same size, and less for frequencies still higher. If, however, no other consideration entered, for currents of very high frequency, and particularly for lighting discharges, which are oscillatory, the best conductor would be one of iron of hollow cylindrical form. But the inductance of the circuit also enters, and as this is greater with iron conductors and but slightly dependent on the shape of the section, it would appear that what is gained in ohmic resistance might be more than lost in inductive drop. The calculation of the exact quantitative relation of the two phenomena would furnish an interesting problem to those versed in higher mathematics, and perhaps give occasion for an original solution, though there is a risk that it is buried somewhere in Heaviside's works. The exact formula for the calculation of the increase of resistance due to frequency is one of extreme complexity, a solution for a single case requiring an inordinate length of time. Mascart finds, however, that it may be represented within practical limits, with a relative error inferior to thousandths, by a very simple expression.

Van Depoele Trolley Patents.

The United States Circuit Court of Appeals which reviewed Judge Coxe's Elmira decision relating to the Van Depoele patent on overhead trolley devices, has rendered an opinion reversing some of the points sustained by Judge Coxe and sustaining others. The claims for a combination, with an overhead conductor arranged to receive a traveling underneath contact, of a switching device secured to and depending from the conductor, is declared void, owing to lack of patentable novelty. The several claims, embracing among their constituents an overhead wire and a grooved contact device, or devices which are equivalent of these, are sustained, with the remark that they do not constitute a great invention, but yet requiring a degree of ingenuity somewhat beyond the ordinary skill of the calling. Two other claims relating specifically to the conductor switch are declared void for lack of patentability. The group of claims relating to the trailing trolley and relative arrangement of trolley switches and branch switches is sustained. Of a number of other claims it is held that they are valid as far as they relate to improvements on a prior patent by the same inventor. Application by the defendants have been made for the certification of the case to the United States Supreme Court.

High-Low Pressures.

Referring to the introduction of 220-volt incandescent lamps, the London *Electrician* remarks that "Those responsible for the success of electric supply undertakings have, with one accord, declared that the salvation of 'low-pressure' systems lies in the adoption of what is uncommonly like 'high pressure.'"

E Pluribus Unum.

A recent British patent granted to Mr. J. Swinburne, dated Nov. 30, 1895, is for the following: "Improvements connected with electric telegraphs, organs, condensers, deposition of nickel and cobalt, and with packing eggs and other fragile articles, and coating eyelets and such objects, and making bleaching powder."

Engineering Professors.

It is an unfortunate fact, says the *Journal of Electricity*, that some of our engineering professors are apparently aiming more at their own personal advancement than at the preparation of their students for the duties of life and for a high-principled citizenship, which should be the safeguard of our civilization.

The Philadelphia Electric Trust.

A bill in equity was filed last week in Philadelphia by the stockholders of the Penn Electric Light Company against that company, the Edison Electric Light Company, and the Electric Trust Company, all of that city. The bill asks the court to decree that the Edison Company is not entitled to the exclusive use of the conduits of the Penn Company ; that the indebtedness claimed to be due by the Penn Company to the Edison Company is founded upon an unlawful consideration, and that it be cancelled ; that the Edison Company shall pay to the Penn Company a reasonable rental, to be fixed without regard to the unlawful contract of July 14, 1887, between those companies ; that the stock of the Penn Company held by or for the Electric Trust be cancelled ; that all the conduits of the Penn Company, including those built by the Edison Company, may be used by all persons desiring to occupy them upon such terms as the court shall determine to be reasonable ; that bids be invited for the use of the franchises of the Penn Company, so that renters who cannot be accommodated by the present conduits may furnish the Penn Company with means to perform its public duty by extending its system of conduits and also pay dividends to its stockholders, and that it also be decreed that the management of the Penn Company is collusive, and against the interests of its stockholders, and that relief prayed for may be afforded through the appointment of a Master.

The bill also charges that Andrew J. De Camp, president of the Penn Company, is and has been continually, since his election, a salaried officer of the Brush Electric Light Company and of the Electric Trust; that his salary as president of the Penn Company is only nominal, if he receives any at all ; that his position in the Penn Company is simply that of a confederate for the purpose of managing its affairs in the interest of the Electric Trust and against that of the minority stockholders ; that after his election as president the value of the Penn Company's stock, which had already declined through the machination of the Trust from 50 cents per share, at which price some of it was sold in 1887, fell to five cents per share.

Notes from the Westinghouse Works.

A strike occurred at the Westinghouse Works at East Pittsburg, Pa., last week, involving, however, but a portion of the employees, and principally women, in the winding departments. The strikers claimed that their wages had been cut down and their hours of work reduced. In a statement the day previous to the strike, an official of the company said that 500 men had been put on half time, but that it is likely all will be taken back on full time within a few weeks.

He also added that the company will put in two more boilers, each of 500 hp, which means more work eventually. The works were started but a year ago, yet the power has already been found inadequate. The boilers now in use aggregate 2500 hp. Work on these improvements has already been started, and in addition to the new boilers there will be other extensive improvements.

The strike has been settled and no further trouble is anticipated from employees.

Mr. Albert Schmid, superintendent of the works at East Pittsburg, has left for a tour of several months in Europe, during which he will make a thorough study of European manufacturing methods and the latest electrical advances abroad. Mr. Jules Neher, one of the engineering staff, is at present making a tour of the world, at the conclusion of which he will resume his former duties.

It is rumored that at the meeting of the Board of Directors on Thursday of this week, several reassignments of employees will be made, and that Mr. Zimmerman, who some time ago was transferred to the Pittsburg works, will return to the New York office.

The New Photography.

The recent experiments of Prof. Routgen were, according to the New York *Sun*, successfully repeated in London last week, many of them being shown at a meeting of the Camera Club. The experiments were said to prove that the strange medium which produces images of hidden objects on a photograph plate is not light at all, and that it is equally incorrect to describe it as electricity. It is explained as some influence produced by a Crookes' tube when excited in a peculiar manner, but it is not the visible light or glow which comes from the tube. That visible light has the same qualities as an ordinary light. The invisible new medium has not the same qualities. For instance, it will not penetrate clear glass. It will penetrate ground glass, though more feebly than wood and other organic matter. Aluminum is far more transparent than glass. Even copper is less opague than glass. A large collection was shown of these strange photographs taken at the Camera Club. A half horse-power electrical generator was employed, the current being passed through an induction coil, which charged 10 Leyden jars. The charge from the jars was passed through another induction coil of a secondary system, by which the tube was excited. The experimenter said that he had only succeeded in this way, and had failed with Crookes' tubes excited by an ordinary induction coil.

He showed pictures of the skeleton of a living human hand, a purse containing coins, in which only the coins and the metal clasp of the purse were reproduced, and other objects. The method of procedure was simply to place the object to be photographed between the tube and the usual wooden case containing the sensitive plate in which the negative is placed when carried to and from the camera. The slide is not removed, and an exposure of from four to twenty minutes is required.

Tesla Believes He is Near Success.

The New York *Herald* of Jan. 19 says that Prof. Dewar, of the English Royal Institution, cabled to Mr. Nikola Tesla, requesting him to represent the Institution at an exhibition of the Keely mechanism in Philadelphia. This invitation Mr. Tesla declined, his reasons being given in a letter to Mrs. Bloomfield Moore, of which the following is an extract :

"It is my honest conviction that I am far in advance in certain lines of scientific investigation, which I consider of greater importance for mankind, and I see before me clearly near success. I am impelled by my sense of duty to follow the dictation of my own reason. . . . The problems are difficult, even now, after I have investigated them for many years, and my powers are taxed to the utmost, so that I cannot spare even the smallest effort," etc.

Magnetic Properties of Iron and Steel.*

BY J. A. KINGDON.

The extensive researches of Prof. Ewing into the magnetic properties of iron and other metals are well known to the electrical and scientific world. Commencing in 1881 with an examination of the magnetic properties of a twisted iron wire, and culminating in 1885 in a comprehensive investigation of the behavior of magnetic bodies under the effects of varying and cyclic magnetizing forces, as well as when subjected to mechanical stress and vibration, Prof. Ewing's results may well be regarded as a most valuable contribution to our knowledge of this subject. The recent award of a Royal Society's medal to Prof. Ewing for his researches in magnetism will no doubt therefore meet with general approval from members of the electrical profession.

Prof. Ewing is not, however, the only worker in this branch of science to whom electricians owe a depth of gratitude. It is now just 10 years since Drs. J. and E. Hopkinson discovered the true law of the magnetic circuit, and showed how to predict the behavior of a dynamo from a knowledge of its dimensions and of the magnetic properties of the iron employed in its construction. If a comparison be made between the technical literature on the subject of dynamo design of the present day with what was written before the Hopkinson law of the magnetic circuit was published, it will be clear that the knowledge of magnetism ten years ago was purely qualitative, and that quantitative magnetic calculations were practically unknown.

The value of iron and steel to the electrical engineer depends to a great extent on their magnetic properties. The electrical conductivity of a metal—that is, the ratio of the current to the effective E. M. F.—is practically a constant quantity. The corresponding magnetic property—the permeability, or the ratio of the magnetic induction to the magnetizing force—is, on the other hand, in the case of magnetic bodies, very far from being constant. In the case of good soft iron or mild steel with a small percentage of carbon at ordinary temperatures, and under the action of a gradually increased magnetizing force, the permeability is low initially, but increases very rapidly to a value of about 2000. This, however, is by no means the limit of the value of the permeability, as Dr. Hopkinson has shown that when iron is heated to a temperature of 770° C. the permeability, under the action of low values of the magnetizing force, attains the high value of 11,000. At this temperature, how-

*From the London *Electrical Review*, Jan. 3, 1896.

ever, it is found that the magnetic flux intensity cannot be raised to high values, and with a very slight increase of temperature the metal loses its permeability altogether, and becomes practically non-magnetic at 785° C.

At ordinary temperatures the highest value of permeability is attained in the case of wrought iron at a magnetic flux intensity of about seven kilogausses. After this point the permeability becomes gradually less. Prof. Ewing has investigated the permeability of iron under very great magnetizing forces. Under the enormous magnetizing force of 24,500 gilberts a flux intensity of 45,350 gausses was obtained, so that the permeability was only 1.85, or little more than that of air.

In the design of dynamos the electrical engineer has to be content with much lower values of the magnetizing force, in order to reduce the power required for excitation within reasonable limits. It is accordingly of importance to obtain magnetic material of a high permeability for values of flux ranging from 10 to 16 kilogausses. The advantages of wrought iron over cast iron in this respect are well known, and of late years steel, with a small percentage of carbon, has come into use for electromagnets, it being found that the carbon, instead of lowering the permeability, increases it. In the massive yoke rings that support the revolving field magnets of the 5000-hp Niagara alternators, tensile strength was of even greater importance than magnetic permeability. These rings are made of nickel steel of a tensile strength of 36 tons per square inch, and their permeability is equal, if not superior, to that of the best wrought iron, which of course would have a much lower tensile strength.

Prof. Ewing has devoted considerable attention to the study of the dissipation of energy that takes place when a magnetic body is subjected to magnetic reversals. When iron is magnetized, energy is absorbed, and remains stored up in the molecules of the metal as long as the magnetic flux is retained. Upon the removal of the magnetizing force, part of this energy is given out in heat in the exciting circuit, but a considerable amount may still be retained in the metal, owing to the residual magnetism. If a demagnetizing force is applied, so as to destroy the residual magnetism, it is found that the energy stored in the magnet is dissipated in heat. When iron is subjected to a periodic alternating M. M. F., the energy dissipated in heat may be found by a formula due to Mr. Steinmetz. If $\mathfrak{B}$ is the maximum value of the magnetic flux intensity, n the frequency of the exciting current, v the cubic contents of the iron in cubic centimetres, the energy wasted in heating from hysteresis is $v\,\eta\,n\,\mathfrak{B}^{1.6}\,10 \times^{-7}$ watts. The coefficient η depends partly on the chemical composition of the iron and partly on its hardness. For soft iron, η is .002, and for hardened steel, .025. It has been found that iron forming the core of a transformer has not a constant hysteresis coefficient, but that in some cases the value of the coefficient increases gradually during working. It has been thought that this increase of the hysteresis coefficient, and the accompanying decrease of permeability, may be due to some obscure magnetic action, but experiments made by Mr. Mordey go to prove that it is due to the rise in temperature to which the cores of transformers are subjected. It is, however, quite possible that different qualities of iron or steel may have different properties in this respect.

In the manufacture of permanent magnets it is of importance that the material employed should retain a large percentage of residual magnetic flux, rather than that it should be of very high permeability. The permanence of the magnetic properties of a piece of steel depends on the "coercive force" of the metal, that is, the reversed magnetizing force required to reduce the steel, after it has been strongly magnetized, to a non-magnetic state. Dr. Hopkinson, who has given this definite meaning to the term, has found the coercive force of tungsten steel to be 51, while that of soft iron is only 1.6 C. G. S. units. As the M. M. F. of a permanent magnet is obtained by multiplying its length in centimetres by its coercive force, it is clear that a high value of the coercive force, which is very prejudicial in transformer iron, is in this case an advantage.

While tungsten has the property of greatly increasing the coercive force of a sample of steel, it is found that steel containing about 12 per cent. of manganese is perfectly non-magnetic. This is a result which might be expected, since manganese, in spite of its close resemblance to iron in chemical properties, is impermeable to magnetism. Besides iron and some of its alloys and compounds, the only magnetic bodies are nickel and cobalt. The latter metal and cast iron are nearly on an equality as regards permeability, but nickel is less magnetic. An alloy of iron containing 25 per cent. of nickel has been found by Dr. Hopkinson to have extremely peculiar properties as regards magnetism. At ordinary temperatures this alloy is non-magnetic, but if its temperature is reduced a little below the freezing point, it becomes magnetizable. It then retains its magnetic properties until it is heated to the critical temperature of 580°, when, like other varieties of iron, it becomes non-magnetic, but, unlike them, it does not regain its magnetic permeability until the temperature is again reduced below the freezing point. At ordinary temperatures, therefore, this alloy may be either magnetic or perfectly non-magnetic, according to the previous history of its temperature.

Relative Cost of Gas and Electricity.

In a report made to an English electric bicycling company by Mr. A. P. Trotter, formerly editor of the London *Electrician*, and reprinted in *Engineering*, an interesting comparison is made as to the cost of lighting by gas and by electricity, the figures given being based on a series of photometric tests. The lamps used in the electrical tests consisted of three Edison-Swan 16-candle-power 100-volt lamps, which had been in use for some weeks previously; three "Gabriel" 16-candle-power 100-volt lamps, which were new; and one Edison-Swan "Sunlight" 100-candle-power lamp, intended to work at 100 volts. The comparison was made under fairer conditions than is usual in such tests, as good ordinary burners were used in place of the Argand, so dear to the heart of the gas engineer when engaged in endeavoring to prove the superior economy of his product. These burners consisted of a "Christiania" burner tested with and without its opal globe, three steatite "Union" burners of the Bray type, two of which were marked No. 5 and the other No. 6, and one slit batswing burner. The results given below were obtained in these tests:

Lamp.	Volts.	Amperes.	Watts.	Total Candles.	Candles.	Watts per candle.
E. S. 16	103	1.82	187.0	61.0	20.3	3 20
E. S. 100	102	2.46	251.0	..	103.0	2.43
Gabriel	102	1.70	173.4	52.5	17.0	3.03

Burner.	Cubic Feet per Hour.	Total Candle-Power.	Candles.	Candle-Power per Cubic Foot per Hour.
Christiania	6.2	..	13.4	2 16
Ditto, with globe	6.2	..	7.9	1.27
"Bray"	34.0	39	13.0	1.15
Batswing	16.0	..	38.0	2.38

The cost of glow lamp renewals is estimated at 3 cents per 1000 candle hours, and, with this figure, the cost of the electric light, when the supply is delivered at 12 cents per kilowatt-hour, works out as follows, 1 cubic foot of gas being taken as giving two candles per hour:

Lamp.	Candle-Power.	Watts per Candle-Power.	Equivalent Price of Gas.
E. S. 16	20.3	3.20	85 cents.
E. S. 100	10.3	2.43	66 "
Gabriel	17	3.03	81 "

If lamps taking three watts per candle-power are used, Mr. Trotter estimates the relative value of electricity and of gas thus:

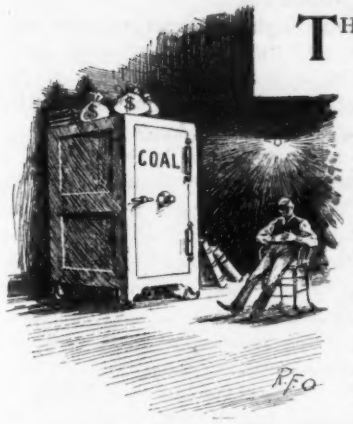
Electricity at 8 cents per kw-hour = gas at 58 cents per 1000 cubic feet.
" 12 " " " = " 83 " " "
" 16 " " " = " 108 " " "

Altering the efficiency of the lamps has a considerable effect on the cost of lighting. Thus with electricity at 12 cents per kilowatt-hour, the cost of renewals per 1000 candle hours is 2 cents, and the cost of the light would be equivalent to that of gas, at $1.04 per 1000 cubic feet, two candles per hour being taken as the equivalent of 1 cubic foot of gas. Running the lamps at 3 watts, the cost of renewals would be 4 cents, and the cost of lighting equal to gas at 81 cents. If the efficiency of the lamps is raised to 2½ watts per candle, renewals may be reckoned at 8 cents per 1000 candle hours, and the cost would be equivalent to gas at 79 cents. For outdoor lighting, Mr. Trotter has compared the cost of running arc lamps and the Welsbach burner. As a favorable estimate he considers that the latter may average 53 candles from 3½ cubic feet of gas per hour, during the life of the mantles. Adding the cost of new mantles as estimated by the makers, he finds that a naked light of 500 cp thus obtained would cost 2.8 cents per hour, no account being taken of the cost of maintenance, cleaning, repairs, etc. The contract price of the arc lamps, as used, is 3.9 cents per hour for the same light, this cost being inclusive.

Central-Station Working—IV.

ECONOMIES IN SMALL CENTRAL STATIONS.

BY GEORGE L. THAYER.



THE subject of this article relates more particularly to central-station plants in towns of from 3000 to 5000 inhabitants. Such plants consist usually of direct-current arcs for street and commercial lighting, and an alternating incandescent system. They were installed from five to eight years ago, and are now reaching a point where the equipment is pretty well loaded up, and in some cases badly overloaded. The problem to be solved is not how to tear down and rebuild, but how to make the best use possible of the property as it is. To this end it is sometimes necessary to take steps which in ordinary cases might savor of bad engineering but which in special cases may be the best way out of the difficulty.

Stations are often badly hampered with respect to making extensions by neglect in the original design, undue expense being thus entailed. Where extensions are about to be made special care should be taken in adapting the engines to the load of the station at different times of the night. The smaller the plant the more important does this question become. In stations having only two engines—a very common type—it is desirable to have the engines of different sizes. The larger engine will then be used for the heavy evening load, the smaller engine merely helping it out. It is advisable to equip this small engine with more than its rated capacity in dynamos, if both arc and incandescent lights are used. The station can furnish either arcs or incandescents up to its full engine and boiler capacity. After the evening load has gone off this engine can carry both the street lighting and the incandescent load, which is always small after 10 p. m.; stations which run all night will have the engine working at nearly the normal load through the night, while in the Winter it will be able to pick up the incandescent load, which becomes quite large on a dull morning, the street lights being out before the maximum load comes on. Starting up the larger engine may be avoided if the incandescent load on the smaller engine is great enough. A good rule to follow is to run from it an incandescent machine equal to its full capacity and an arc machine large enough to carry the street lights.

It is better to make the mistake of overloading rather than underloading an engine with dynamo capacity. A good engine will stand an overload of 25 per cent. or more with safety, and with but a slight increase of steam per horse-power. On the other hand, an underloaded engine, even a Corliss, is always a coal-eater. With the efficiency of an engine at rated load taken as 100 per cent., the curve in Fig. 1 shows the change of efficiency with various loads on the engine. It will be noticed that with an overload of one fourth, the efficiency drops off only 3 per cent., while at a three-quarter load the efficiency falls almost 10 per cent. At half load it is 75 per cent. In another form it figures as follows: If the engine at full load is taking 100 pounds of coal per hour, at half load it would require 65 pounds per hour. If the load were carried on an engine of half the size, the coal consumption would be in the neighborhood of 55 pounds, allowing for the lower efficiency in general of a smaller engine. The gain in this case would be 15 per cent., an important item where coal is high. The practice of putting in a single Corliss engine and running all the machines from it will always result in a waste of fuel. The high efficiency on full load will be more than offset by the poor efficiency on light loads.

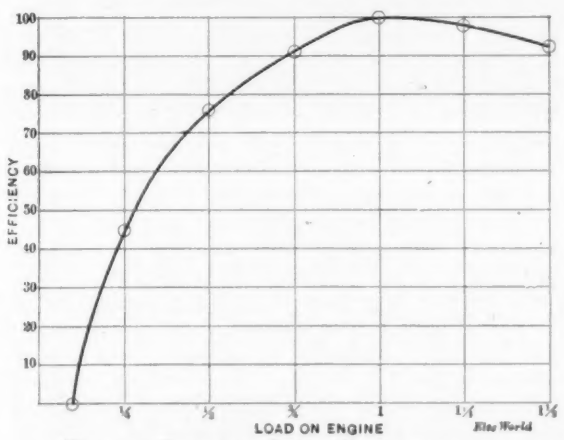


FIG. 1.—CURVE OF LOAD EFFICIENCY.

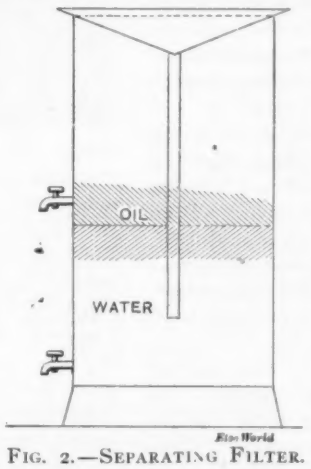
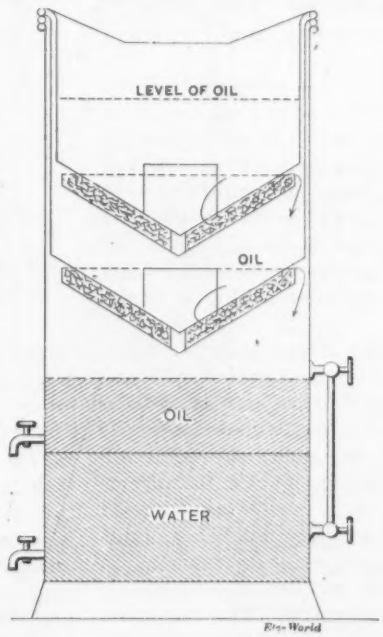
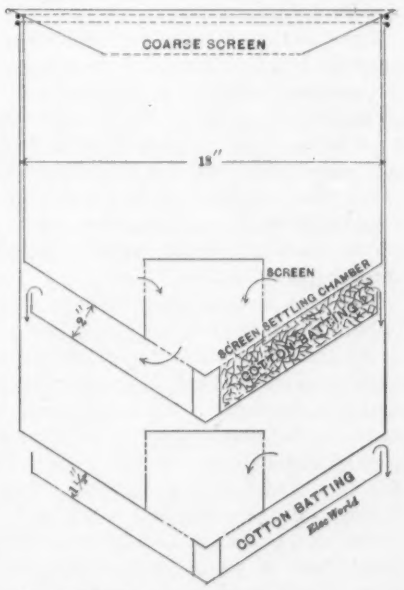


FIG. 2.—SEPARATING FILTER.

The matter of engine room supplies in general must depend upon the special requirements of each plant. The waste in lubricating oil is always much larger than need be. High-speed engines sling a great deal of oil. The money spent in a carefully designed system of splash pans is never thrown away. The oil bill is frequently cut down surprisingly by stopping a few little leaks. With good splash pans a higher grade of lubricating oil can be used and be filtered over and over without any apparent loss in body or lubricating power.

A pair of filters described here, and shown in Figs. 2, 3 and 4, is in use on a plant running all night. The equipment consists of one 100-hp compound, and one 50-hp simple engine, both high speed, and connected with two arc machines and two alternators. One barrel of oil costing 45 cents per gallon lasts over six months. The oil is filtered over and over, becoming a little darker, probably from a small admixture of cylinder oil. New oil is used from time to time as the supply gradually diminishes. Both filters were made of galvanized iron at the local tin shop. The first filter (Fig. 2) is simply a separating chamber for the oil and water. The object of the funnel is to avoid disturbing the body of clear oil floating on the water. From this filter the oil is drawn and poured into the second or real filter (Fig. 3). This filter is 18 inches in diameter and 48 inches high. It consists of a main receptacle with a settling reservoir over water, two removable filter chambers and a straining screen to catch loose waste. The filtering chambers fit into the main body like a nest of deep saucers. Each chamber (Fig. 4) has a small cylinder at the bottom with circular screened openings in the vertical wall. This is to prevent the first settlings from passing further down into the cotton batting. Below the chamber is a flat cone, conforming to the shape of the bottom. This is filled with cotton batting. The course of the oil is shown by arrows. To get the best results, the batting should be packed sufficiently tight that the filter will just keep pace with the oil consumption. The complete outfit will cost from $10 to $15, depending upon the fittings used.





FIGS. 3 AND 4.—OIL FILTER.

There is a chance for saving by a careful arrangement of the sizes of transformers, especially in the residence district, where the transformers are small. Unless care is used the transformer iron losses

may become a serious drag upon a plant. Houses should be grouped as much as possible upon one transformer, and 110-volt lamps used. There is danger, however, of carrying this principle too far. For illustration, take two houses of 10 lights maximum load, and figure the relative costs of one transformer for two houses, and of a transformer for each house. The extra cost of labor in running longer secondaries will about balance the labor necessary to install the second transformer. At current factory quotations, $10 will be saved by purchasing one 20-light instead of two 10-light transformers. The saving will pay for 250 feet of line, using No. 6 weatherproof wire. So far the investments are equal. As to the results of operation, the drop in the secondaries at full load is 1 per cent., and at ordinary loads less than one half per cent. The saving in iron losses would be about 20 watts. On the basis of 14 hours per day, and coal at $2.50 per ton, and eight pounds of coal per kilowatt hour, $1 worth of coal would be saved per year. As the average evening load in the residence districts will be about four lights per house, the iron loss would be about 14 per cent. in one case and 9 per cent. in the other of the evening load. Putting it in another way, for every six houses so connected up, current equal to one 16-cp lamp burning all the time will be saved. This is an extreme case, and the gain is less when a 40-light transformer displaces two of 20 lights each. In blocks of the ordinary length—500 to 600 feet—it will rarely pay to install more than one transformer. In the business district it may pay to put in two when the load for the block exceeds 150 lights. The higher the cost of fuel and the greater the number of hours a plant runs per day, the more important are the transformer iron losses and the greater distance it pays to run secondaries.

In designing a transformer the iron loss can be cut down at the expense of the regulation. On the other hand, better regulation can be had at the expense of an increased iron loss. It follows from the relation between iron loss and regulation that what is best on an all-day plant is not the best on a plant that shuts down at midnight. When station managers in general begin to inquire for a transformer suited to their particular needs, manufacturers will put on the market transformers of different iron efficiency, much as we now have lamps of different efficiencies to suit different conditions.

The matter of replacing old transformers with new ones having very much smaller iron losses will nearly always pay. Some of the old makes have iron losses amounting to 10 per cent. in 30 and 40-light sizes. The conditions are worse in the smaller sizes. Some transformers are offered in the market for a song, but these are a good thing to steer clear of. A recording wattmeter may be used for measuring the iron loss, which can be done by connecting the secondary of one transformer with the secondary of another transformer whose primary takes current from the 1000-volt circuit. The wattmeter then connected up in the secondary circuit will measure the watts absorbed by the transformer under test. The method is fairly accurate and can be made with the type of meter regularly used in lighting service.

The question of meter versus contract rates is coming more to the front the last few years. Station managers are usually satisfied with the existing condition of affairs and do not care to go to the expense of putting in meters. They argue that as meters will cut a bill of $3.00 to $2.50, the plant will be the loser: that on contract rates a customer knows what his bill is and will not kick at its amount. As to the first objection, the loss is only an apparent one, and as to the complaints of consumers, nine tenths of them come from a distrust of the accuracy of the meter. A little patience will stop all the chronic grumblers.

The two underlying principles of meter service may be stated to be: First, in all classes of lighting where the consumer can save in the amount of current used, meters should be put in. Second, the higher the cost of fuel the greater the profit of meter consumers over contract consumers. In commercial lighting where the hours are more regular than in any other class of lighting service, the advantage of meters is not marked. Very little light can be saved except during the first hour of lighting. The maximum number of lights in use at any one time will be about the same, meter or contract. In residences, church or hall lighting, the case is different. There is a great deal of waste light which can be cut off. The maximum current used by such consumers, as well as the length of time the lights are in use, will be very greatly reduced by meters. Aside from the saving in coal, the capacity saved is available for new business when the station becomes loaded up. It has been urged that meters subject the station to a more variable load. This is true, but it is so because the extra load which appears only at Christmas, New Year's, etc., is the wasted light of other periods of the year. This maximum load comes in the Winter, when the incandescent machines can better stand an extra load, because of the cooler engine room.

As to the actual results in residence lighting, the maximum will ordinarily be cut down 25 per cent., and the number of lamp-hours at least 40 per cent. It can easily be seen that meter rates can be made which will make the size of the bills the same or a little smaller, while the station load is cut down a much larger amount.

The meter manufacturers are to-day in a position to make the offer that the makers of Corliss engines made in early days. They can put in meters and make money by taking as their pay the increased earnings per horse-power in the output of the station. The writer has in mind a station which in the last year has placed practically all its new business on meter. The rentals have increased $50 per month. The increased station load on contract rates would have brought in $36 per month. At the same time the average monthly bills are somewhat lower than contract rates.

The Up-Building of a Small Town.

At the Milwaukee meeting of the Northwestern Electrical Association, Mr. Fred. DeLand read a paper with the above title, in which he considers the subject with respect to street lighting. The remark of a Michigan merchant is quoted, to the effect that in his town, of nearly 3500 inhabitants, a marked growth in population and prosperity had its inception in the order of the village board directing that electric lights be employed in illuminating the streets by night. The arc lights, he stated, gave the citizens a taste of progressiveness and awoke in them a desire to have other improvements. Later the main streets were all paved with asphalt or with brick, and additional lamps were placed at street corners. Then some old frame stores that had been a fire menace for years were torn down and a modern office building erected on the site. These improvements furnished the local editor with something to talk about, and soon the fame of the town had penetrated into nearly every hamlet in the neighborhood. There are now not less than seven factories, one of which employs 180 hands, and five large modern stores, to say nothing of numerou small shops, two new school-houses, three churches, and 583 new dwellings and other buildings which have been erected since the arc lamps were placed in circuit. The merchant considers that if arc lighting had not been adopted, the town might still be jogging along in the old way with a dozen oil lamps.

Another incident was related concerning a village which, though blessed with natural advantages far superior to those possessed by neighboring towns, decreased in prosperity, while surrounding towns grew in wealth. Finally, a shrewd old man of wide experience and broad views secured a franchise for an electric lighting plant, and an order for six street lamps for a long term of years was granted by the town. All of these lamps hung within sight of the depot and 30 days had not passed before there was an influx of visitors, and the townfolk began preparing houses, trimming trees, repairing sidewalks, etc.! Since then a regular healthy growth has been experienced and the average value of real estate is stated to be five times what it was seven years ago. Mr. DeLand refers to another town which increased from 683 to 1006 inhabitants, or an increase of 47 per cent., from the day modern progressive methods, including electrically-lighted streets, were introduced, and added that a dozen other electrically-lighted villages all show marked gains, while their neighbors with dark streets have slowly degenerated.

Government Engineering Laboratories.

A bill has been introduced into Congress for the establishment, in connection with State colleges and universities endowed with the proceeds of national land grants, of experimental stations for the mechanic arts, which shall, in their relation to engineering education and scientific investigation, be analogous to the several existing State agricultural experiment stations with respect to agricultural science. To accomplish this it is only necessary to extend the provision of the Hatch Act of 1887 to embrace the mechanic arts. It is proposed that the internal organization of such engineering experimental stations follow closely that of the official stations now to be found in every large German town in connection with its university and technical school, and, especially, of the mechanical testing station at Charlottenburg, Germany. It is advocated that what has been done by private munificence in several of these lines of engineering in the laboratories of our technical schools, should be extended and made possible by federal aid in every land grant college and university.

The Niagara Street Railway Transformer Plant.

Power for the operation of the Buffalo & Niagara Electric Railway and the Suspension Bridge Electric Railway is obtained from the Niagara Falls Power Company in the form of a two-phase alternating current at a frequency of 50, converted into a direct current through the intermediary of two static and one rotary transformers. The two-phase currents from the 5000 horse-power Niagara generator is carried to the main bus-bars by four cables of 600,000

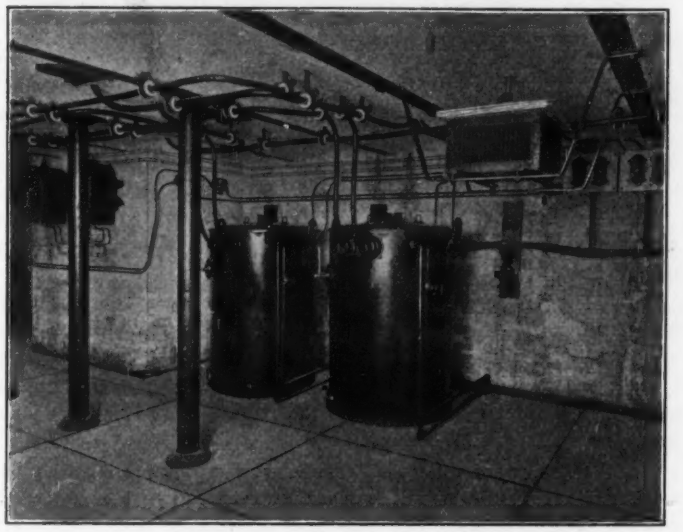


FIG. 1.—500-HP ROTARY TRANSFORMER.

circular mils each; they then passes to the two static transformers, the secondary currents of which at a reduced voltage operate the rotary transformer, which supplies direct current at 575 volts to the line.

The cables are connected to the middle portion of two double pole, double throw switches, and when these switches are thrown up the currents pass into an auxiliary static transformer, the secondaries

FIG. 2.—STATIC TRANSFORMER.

of which are connected to a two-phase starting motor whose armature is on the same shaft as the rotary transformer motor.

When it is desired to start, both switches are first thrown up, and the starting motor brings the rotary transformer up to speed. Then the field circuit of the main armature is closed and the voltage allowed to build up. Synchronizing lamps determine when the armature has reached the proper speed; these lamps are two in number, and are placed in series with the secondaries of two 2000-to-100 volt converters, the primaries of which are attached, one to the main dynamo circuit and one to the 2000-volt side of the static transformer feeding the rotary. As the armature nears synchronism these lights suddenly grow brighter and fluctuate less, and by keeping a careful watch the operator can determine the proper moment for throwing down the switches, which is when both lights are bright and steady. When the switch is thrown down, the two-phase currents pass through the two static transformers, where the voltage is reduced from 2250 to about 440, the secondary current, of course, increasing in the same ratio. It is at this reduced voltage that the currents pass into the alternating current end of the revolving armature, running it as a synchronous motor. The direct current generated in the dynamo windings of the transformer has a voltage in the neighborhood of 600. The rotary and static transformers were installed by the Westinghouse Company.

Suburban Electric Railways at Cleveland.

There are now, or soon will be, five suburban electric railways radiating from Cleveland, O. The Cleveland & Painesville line unites Cleveland with the seat of Lake County, and is about 23 miles in length from the eastern city limits. The Akron, Bedford & Cleveland Railway has its terminal respectively in Akron, Summit County, and at the southerly limits of Cleveland, a distance of more than 30 miles. The Cleveland & Berea Company is operating from the southwesterly city limits to Berea, having about nine miles of single track exclusive of switches and turn-outs. The Cleveland & Elyria line has just been completed, and extends from the westerly limits of Cleveland to Elyria, the seat of Lorain County, a distance of over 20 miles, while the Lorain & Cleveland line, which will be ready for traffic in the early Summer, connects Lorain, the growing lake port and steel manufacturing town on the Lake Shore, west of the city, with the westerly limits of Cleveland, and will have about 22 miles of track exclusive of switches and turn-outs. At present these lines end at the limits of the city and depend upon the city electric lines to bring their passengers to the centre of the city.

The above lines are controlled by a syndicate of local capitalists headed by Henry A. Everett, which has applied for a franchise for 85 miles of road in the streets of the city. It is proposed to operate these city lines in conjunction with the suburban roads as a single system, and to use the city streets between the hours of midnight and 5.30 a. m. to bring in country produce of all sorts. It is proposed to erect a large terminal station for the handling of freight and the accommodation of suburban passengers, and later, as freight traffic increases, to construct small freight stations in different sections of the city along the lines of the road in order to supply every section with country produce with as little handling and at as small expense as possible. The roads are all incorporated under the steam railway laws and expect to condemn property where necessary to cut through in order to secure more direct routes.

The new company proposes to give transfers good over the entire system, and to sell eight tickets for 25 cents, with the right of transfer. It is said that the company will also haul freight from one part of the city to the other, thus handling produce of manufacturing works now carried in trucks.

The present Cleveland electric railway companies have begun a bitter fight, and threaten that if the new line secures a franchise for streets in the city, they will cut the rate to three cents. As an example of the electric competition with steam roads, the *Evening Post*, from which we obtain the above information, states that though the Akron, Bedford & Cleveland Railway Company has operated cars between Akron and Cleveland for less than four months, it has already made such inroads into the business of the steam road with which it competes that the latter has already laid off two of its way trains between the points named.

Electric Fans in Winter.

Storekeepers troubled in Winter-time with frosted windows will find that through ventilation, by means of electric fans, this source of annoyance may be obviated. In some cities the electric fan is beginning to be extensively used for that purpose.

Milwaukee Convention of the Northwestern Electrical Association.

The fourth annual convention of the Northwestern Electrical Association was held in the clubroom of the Hotel Pfister, Milwaukee, Wis., on Jan. 15, 16 and 17, 1896, and was one of the most successful meetings in the history of the association, about 100 members and others being in attendance. The convention was called to order at 11 a. m. on Jan. 15 by President George Grimm, and immediately proceeded to the transaction of business. Much complaint was made by various members concerning the numerous errors that had occurred in the printed report of the proceedings of former meetings, and it was decided that hereafter the stenographic report of the remarks of each member shall be submitted to him before being given to the press. As a consequence of this, we are unable in this issue to print other than abstracts of several papers of which copies were supplied in advance of the meeting. The remaining papers and discussion will appear in our next issue.

The attention of the meeting was called to the fact that at each convention the treasurer's report showed a deficiency, and the advisability of raising the annual dues from $5 to $10 was discussed. The treasurer reported that the association was indebted to him to the extent of $80, and that besides he had expended from his own purse about $300 for legislation, which latter amount, however, he did not ask to be refunded.

The Programme Committee reported that they had secured the following papers, to be presented at the meeting:

1. "Modern Apparatus vs. Existing Conditions," by W. J. Buckley (an abstract of which appears in another column); 2. "Economical Expression for Fuel Values," by A. V. Abbott; 3. "A Blackboard Talk on Central-Station Economics," by L. L. Summers; 4. "Storage Batteries in Central Stations," by Maurice Barnett (an abstract of this paper appears in another column); 5. "Some Facts About Acetylene Gas," by J. C. McMynn; 6. "Arnold Electric Power Station," by E. R. Cunningham (which is printed in abstract in another column); 7. "The Up-Building of a Small Town," by Fred De Land (an abstract of which appears elsewhere in this issue); 8. "Economical Results in Modern Arc Lighting," by F. E. Drake; 9. "Water Purification by Steam," by John M. Wilson.

President George Grimm then delivered his annual address, the opening paragraphs of which referred to several unsatisfactory features in the organization and management of the association, for which remedies were proposed. The association was also asked to distinctly define the extent to which it should go, and to which its officers and committees were authorized to act, in furthering proper legislation relating to electrical industries, and incurring expenses in connection therewith. Mr. Grimm said that during his period of office he had been solicited by several persons from different States to give information and assistance in overcoming adverse legislation, furthering proper legislation and similar matters. In each case he had replied that the scope of his office did not permit him to take any hand in the matter, that the object of the association was not to interfere in legislation except so far as the experience gained by the members and their influence as individuals would aid in that direction. He considered it desirable, however, to clearly define the position of the association in this respect for the guidance of future officers. He does not believe it is practicable for the association to take a hand in legislation except as in the manner indicated, owing to lack of funds and the extent of territory covered, but the association could, he believes, with little or no expense do most material good to the electrical interest and aid in bringing about laws just in themselves and adapted to the wants of the times. It could draft and propose laws that would take the place of the unjust measures presented at almost every session of Legislatures, which would receive the support of all right-minded citizens; it could also, as in the State of Wisconsin, completely answer all adverse arguments by proposing to meet the public demands by just laws and in an honorable manner. By drafting a uniform system in that line, to be submitted to the Legislatures of the different States by the individual members of the association, and not by the association as a body, opposition would be disarmed and untold good accomplished for the electrical interests without incurring any expense.

Mr. Grimm referred to other matters calling for attention on their part. The rules of wiring, etc., adopted by various boards of underwriters are, he said, frequently oppressive and impracticable in many details. The safest body of men to draft these rules, he believes, are practical electricians, and a thorough system embodying the best experience of both underwriters and electricians would be safer and less oppressive than those now in existence.

Convention Notes.

The Hartley Electric Works was represented by Mr. Bernard Hartley.

The Chicago General Fixture Company was well represented by Mr. C. O. Baker.

Mr. A. C. Bunce, of Milwaukee, was, as usual, one of the leading spirits of the association.

The Western Electric Company, of Chicago, was most ably represented by Mr John W. Ebert.

The Forest City Electric Company, of Cleveland, O., was represented by Mr. J. M. Atkinson, its Chicago representative.

Mr. Albert Smith, of Keelyn & Smith, of Milwaukee, received his many callers very cordially, and extended to them the keys of the city.

The Milwaukee Auxiliary Fire Alarm Company was represented by Mr. Thomas Marcein, who apparently held his own, the gallant fifty.

The Central Electric Company, of Chicago, was represented by Mr H. M. Latimer, who extended a friendly hand and unbottled good wishes to all visitors.

The Electric Storage Battery Company, of Philadelphia, was strongly represented by its very popular and much admired Western manager, Mr. C. W. Woodward.

The Westinghouse Glass Factory was represented by its Chicago agent, Mr. J. H. Reid, another convention favorite, who seemed to have no end of friends.

Mr. L. W. Collins, a well-known conventional warrior, did not leave a stone unturned in pushing the electrical specialties carried by Messrs. Lee & Collins, of Chicago.

The Adams-Bagnall Electric Company, of Cleveland, O., was represented by Mr. L. H. Rogers. Many kind things were said of this house, and its "A-B" arc lamps were greatly admired.

The American Circular Loom Company was represented by its Western agents, Messrs. H. H. Brooks and A. D. Chandler, who, as usual, displayed great extravagance in the shape of good wishes and advertising contracts.

The Columbia Lamp Works, of St. Louis, Mo., was represented by its Chicago agent, Mr. J. M. Hill, who chaperoned the boys to the theatre and other places of amusement, and was one of the attractive lights of the party.

The Bryant Electric Company, of Bridgeport, Conn., was most ably represented by Mr. Thomas G. Grier, of Grier Brothers, Western managers for the above company, who was to be seen rushing through the corridors late and early.

Westinghouse, Church, Kerr & Company was most strongly represented by Mr. Jerome B. Wilkinson, from their Chicago office, who was undoubtedly one of the most interesting and entertaining representatives at the convention. His "Archibald story" brought down the house.

Mr. E. Dickey, who represented the American Carbon Works, of Nobleville, Ind., says that his company is the largest manufacturer of carbons in the civilized world outside of the Trust. Mr. Dickey was particularly popular with the boys, and his early departure was very much regretted.

The Royal Electric Company, Peoria, Ill., exhibited one of its new transformers with removable coils, under the superintendency of the well-known and old-time favorite, Mr. G. G. Luthy, who did not leave a stone unturned from start to finish to prove the many sterling qualities claimed by his company.

The Sunbeam Incandescent Lamp Company, of Chicago, was represented by Messrs. F. S. and A. S. Terry, who never seemed to lose sight of the fact, after making a thorough examination of the various incandescent lamps of every section of the city, that there were none so lasting in color and brilliancy as the far-famed "Sun-beams."

The Electric Appliance Company was well represented by its energetic and hustling president, Mr. W. W. Low. Mr. Low's graceful figure and catching smile have been one of the chief attractions at Western conventions for a number of years. His early departure from the convention was caused by heavy pressure of business and sickness at home.

The Fort Wayne Electric Corporation had a most conspicuous and desirable exhibit in the shape of a substantial lunch with the

necessary side issues, to which all visitors were received with open arms. The following gentlemen from their Chicago offices were on hand to take charge of their numerous callers: Mr. W. J. Buckley, Mr. C. E. Wilson, and Mr. J. E. Murphy.

THE VALENTINE-CLARK COMPANY was represented by Mr. E. L. Clark, of Chicago, who is a familiar sight at all principal social meetings of this order. He did everything possible to assist in entertaining his many friends. Mr. Clark has not only made a great reputation for himself as a Western business man, but has now broken all convention records as a vocalist with his tenor voice.

THE OSBURN ELECTRIC COMPANY, of Chicago, had on hand its new conduit suitable for buildings. This conduit is made of galvanized steel tubing, with six-inch lengths of porcelain inside, which they claim to be absolutely insulating and fireproof. Our old friend, Mr. Roy Osburn, and his assistant, Mr. William Gallagher, received for their company, and, as a side issue, they had on show a line of their well-known imported woven wire brushes.

THE GENERAL ELECTRIC COMPANY was very comfortably situated in Room 2, at the Pfister Hotel. It had on exhibition two of the Thomson '93 arc lamps, suitable for direct or alternating incandescent circuits, also switches and other electrical specialties. A very attractive moonlight schedule calendar was presented to the visitors. Messrs. F. N. Boyer, A. C. Bruce, M. C. Wheaton and W. L. Howell were on hand to receive their many friends.

THE WIRE TRADE was very strongly represented. Grimshaw and Raven Core, Safety, Simplex, American Electric Works, Roeblings, Crefeld, Washburn & Moen, having on the ground their well-known Chicago representatives, Messrs. Wolff, Austin, Hixon, Donohue and Gordon. Mr. H. J. Gille, Northwestern agent for the Washburn & Moen Company, of St. Paul, was also present. These gentlemen were all exceptionally active for their various companies.

THE PEOPLE'S ELECTRIC COMPANY, of Madison, Wis., was represented by its president, Mr. L. W. Burch, who received callers in royal style. He had most attractive samples of the electric light, street railway and household supplies carried by this new and enterprising company. Mr. Burch also had on exhibition a Paiste arc lamp focusser, standard telephones, and an attractive assortment of photographs of machinery manufactured by the Northern Electric Manufacturing Company, for which the People's Electric Company is selling representatives.

MR. JOHN T. MCROY, of 36 South Clark Street, Chicago, made a display of virtrified terra cotta conduits for underground use which attracted much attention. The material used in construction is shale, which is thoroughly ground and rendered free from all rough particles—a most objectionable feature in some of the conduits heretofore used. During the process of manufacture the terra cotta is subjected to shrinkage to such a degree that a perfectly dense mass is secured, thereby rendering the conduit, when finished, absolutely non-porous. Not only is the terra cotta vitrified throughout, but all surfaces, interior and exterior, are glazed as an additional precaution against moisture. The interior of the ducts being finished perfectly smooth, with rounded edges, there are no projections to impede the drawing in of the cable. The conduit is manufactured in multiple duct form of any desired number (from one to twelve) and size of ducts. The section lengths are about six feet. As the use of cement or concrete is unnecessary, the services of high-priced artisans are not required. The conduit can be installed by comparatively unskilled labor at any season of the year.

Municipal Electric Lighting.

In a letter to the Alameda (Cal.) *Daily Argus*, Mr. John A. Britton discusses adversely the report of the electrician of that city, purporting to give the cost of arc lighting from the city plant. He refers to the fact that machinery for which the city paid approximately $20,000 was sold in seven years for $350, thus giving a depreciation item of $200 per month, while, in addition, during the same period there was paid out for the maintenance of the plant a sum equal to $300 per month. Notwithstanding this, the allowance given in the latest report for repairs and incidentals is only $32 per month, and this includes wear and tear, which Mr. Britton thinks should be charged up at not less than $250. He also criticises the system whereby part of the expense of running the lighting department is charged to other city departments, and showed that, while $618 had actually been paid out in wages on account of the electrical department, only $432.50 was charged against it.

Storage Batteries in Central Stations.*

BY MAURICE BARNETT.

The questions of the adaptability, performance and economy of a storage battery in a central station will be considered in the following order:

1st. Ability of battery to carry peak of load. 2d. Economy of battery to carry minimum load. 3d. Ability of battery to regulate pressure. 4th. Storage batteries in sub-stations.

It is a fact which managers of central stations will testify to that the maximum output of an electric lighting plant is limited to from 1½ hours to at most 4 hours a day. In designing a central station the engineer must choose between several alternatives. First, if he puts in complete steam-power plant of most modern type to handle the maximum load, over half of the plant will be idle the greater part of the day—from which it will follow that the profits of lighting will be greatly reduced by large interest charges and heavy stand-over losses in the boilers. Such a plant, besides being very expensive, has no reserve capacity in case of accident. To off-set the question of large first cost, it has been proposed to introduce the best type of economical machinery to handle the average output, with some less expensive apparatus to take care of the overload.

For the latter work Mr. Perry has proposed gas-engines to drive extra dynamos. Such a plant, while avoiding the stand-over losses to which a boiler plant is subject, and showing smaller interest charges, is open to the objection that depreciation of cheap machinery, not to speak of loss in efficiency, counterbalance the saving in interest. Nor has such a plant any reserve capacity in case of accident. Mr. Perry's suggestion of gas-engines would be valuable were it not for the fact that every failure to ignite would appreciably alter the speed of the dynamos, as gas-engines cannot maintain their speed when obliged to make two revolutions on a single explosion. As a matter of fact, in gas-engine plants a storage battery is considered almost absolutely essential as a regulator and as a reserve against break-down. Lastly, there is the combination of a steam-power plant to handle the average output, and a storage battery to take care of the overload. Storage batteries of central-station type can be installed for this work for about one half what a steam-power plant would cost—making a plant half steam-power and half storage-battery cost only three quarters what an all-steam-power plant would for the same work. Mr. C. L. Edgar, general manager of the Boston Edison Illuminating Company, which is the owner of the largest storage-battery plant in the world, has put himself on record as to the accuracy of the above figures.

A question that arises here is as to the maintenance cost of such a battery. Generally speaking, it should not exceed that of direct generating machinery. In work of this kind, therefore, the storage battery has undoubted economic values, and suggests the way of designing a central station that will be only moderately expensive and which will be safe-guarded against stoppage arising from accident to the generating machinery.

Coming now to the question of using storage batteries to carry the minimum load, it may be said that opinion is divided on this point. Abroad, where the motor load is insignificant, the minimum demand for power lasts for half a day. It is thus possible to get along with a single shift of men and something is also saved by drawing the fires, banking the furnace fires or other practice when it is not intended to run the plant, and it is considered more economical to let the battery take care of the minimum demand than to handle it with the direct minimum machinery. In this country the motor load is very important and the minimum load lasts from only four to six hours a day. A whole shift of men cannot thus be saved. Experiments have been tried in Boston on a large scale with a view to ascertaining the value of a storage battery in this connection. As yet no definite conclusion has been reached on this point. Undoubtedly there are numerous cases where the minimum load is small and lasts for half a day at least, thus making it economical to use a battery. The Germantown storage-battery plant is a case in point where most satisfactory results are obtained by using a battery in such a connection.

One of the most important and valuable functions of a storage battery in a central station is as a regulator of pressure. To any one who watches the variations in the voltage and amperage of generators, running with and without storage batteries, conviction will soon come that the voltage varies perceptibly less when a battery is

* Abstract of a paper read before the Milwaukee Meeting of the Northwestern Electrical Association.

arranged in parallel with the generator than when it is not. When a shunt-wound dynamo, such as are used in central stations, is running alone, any increase in ampere output will be attended by a fall in voltage. When, on the other hand, a battery is combined with the dynamo, the moment the pressure falls from a large demand for current on the line, the battery begins to discharge and thus augments the output of the dynamo. In other words, the battery acts as a reservoir ; when the load on the line is small the battery is charged ; when the load becomes heavy the battery begins to discharge, and in so doing performs a doubly valuable function. In the first place, it saves the generating machinery from strain, and, secondly, by keeping the pressure constant, makes possible a much higher efficiency, both in the station and on the line. Mr. Edgar has said that if a steam plant and a battery plant were on a par in all other respects, he would personally feel very much inclined to install a battery plant for the above reason alone.

Lastly, we come to the question of the use of storage batteries in sub-stations. Imagine a city which has spread out irregularly. At some distance from the central station it may happen that the population is large and that considerable current will be required to furnish adequate light. If the situation is such that it is cheaper to furnish light from the central station than to operate a small power-plant as a sub-station, the former will be done. The consequence of this will be shown in very heavy losses in the line owing to large currents transmitted, and, secondly, there will be heavy interest charges for very large conductors. If, on the other hand, a storage-battery sub-station were located in the centre of this suburb, the following economies would be gained: In the first place, much smaller conductors would be employed, resulting in diminished interest charges, and, secondly, a high-tension current would be used in transmission by which losses on the line would be lessened. These economies are brought about by the ability of a battery to act as a transformer. In other words, the battery may be charged in series with a high-tension current, and discharged in multiple, thus bringing the pressure at the sub-station down to requirements.

On the other hand, a battery may be charged in multiple and discharged in series, by which it will be possible to get along with one dynamo instead of two or more in series. Owing to the flexibility of storage batteries, they are perfectly adapted to working on a three-wire or a five-wire system.

There is one point that has not thus far been touched upon—namely, the local consumption in a station consisting of both generators and batteries. The use of storage batteries is sometimes objected to on the ground that there is a loss of 15 to 20 per cent. of the watts generated while the battery is being charged. Perhaps we can do no better than by quoting Mr. Edgar again: "The watts lost," says Mr. Edgar, "by the inefficiency of the battery are made up more than fourfold by the better economy of the steam plant. We have taken typical Winter days and figured out exactly the cost of running our system with the battery and without, and have proved that the actual coal consumed with the battery is a material amount less than without it."

To recapitulate, storage batteries are valuable in central stations on account of the threefold function they perform as reservoirs of energy, regulators of pressure and transformers of high to low or low to high tension currents. In performing these functions they make possible lower first cost in the main central station and lower first cost for conductors between this and the sub-stations where batteries may be installed. They are further valuable in saving the power and generating machinery from strain, and in effecting economy by introducing the factor of high efficiency in the station and on the line.

Central-Station Economy.

At the annual meeting of the Northwestern Electrical Association at Milwaukee, Mr. W. J. Buckley read a paper on "Modern Apparatus *vs.* Existing Conditions," in which he discusses various questions of interest to the central-station man.

Mr. Buckley advises that in case a charge for a 2000-cp arc lamp is regarded as too high by a customer, that he be furnished with a smaller arc lamp or a large incandescent lamp service at meter rates, the latter being a money-making factor which he believes to be too much ignored. He believes that the Welsbach burner has come to stay, and that, therefore, close attention should be given to methods of meeting its competition. The first change should be to increase the candle-power lamps to a competitive brilliancy, which, with a meter service, he states can be done, not only without loss, but with a positive gain. The inefficiency of small transformers is referred to and the statement made that four out of seven stations recently tested by Mr. Buckley showed that less than two thirds the current generated reached the lamps. One station employing an 1800-light, 1000-volt alternator, with 1842 lamps wired, delivered 70, instead of 50, amperes at the switchboard with 840 lamps burning. A test showed that current for 1400 lamps was generated with a constant loss of 28 amperes, which, it is added, should not exceed eight amperes; it was also found that the station had a constant loss of 20 amperes. Mr. Buckley states that this useless loss was eliminated by putting in triple petticoat porcelain insulators in place of single petticoat glass ones; removing one fixed and one intermittent ground on the line and changing 1400 lights from 5, 10 and 25 light 50-volt transformers to two 250-light, eight 100-light and two 50-light 100-volt transformers. The remaining 400 lights on the residence circuit were changed from 50 to 100 volts. In addition, meters were put in, with the net result that the losing station was converted into a paying property.

The use of large units is advocated. It is stated that a dynamo running at 600 revolutions weighs nearly twice as much as one of the same design and rated capacity of 1200 revolutions, and costs 70 per cent. more to build. When the armature is built directly on the extension of the engine shaft, this may be reduced to 50 per cent. on account of doing away with one box, pedestal and part of the frame. A direct-current belted machine of 100 horse-power or 1000 lights capacity is cheapest when of the bipolar type, and with a speed of 1200 revolutions and weight of 6000 pounds, costs $900, the average efficiency being 80 per cent. and the life of the armature two years, if loaded. A multipolar machine running at 1100 revolutions and weighing 6500 pounds costs $1000, the efficiency and life being the same as the bipolar. A machine running at a speed of 550 revolutions and weighing 11,000 pounds costs $1400, has an efficiency of 85 per cent. and the armature has a life of five years. A slow-speed machine running at 275 revolutions weighs 17,000 pounds, costs $2200, has an efficiency of 87 per cent. and the life of the armature is eight years. A 150-kw alternating-current dynamo rated at 130 amperes and 1150 volts is worth but 86 per cent. of one of equal capacity rated at 150 amperes and 1000 volts—the first being the output at the dynamo, the latter at the output at the centre of distribution. This difference is reduced to 75 per cent., if the first dynamo is rated at full capacity and the latter at its most efficient output. An estimate of the saving with direct-connected apparatus is given, showing that it is 10, 20, 30, 40 or 50 per cent. with apparatus of 100, 200, 300, 500 and 1000 kw, respectively. In arc apparatus it is stated that speed and weight also govern the price in the same degree as above. It is advised that no reliance should be placed on the insulation of arc lines, the wires of which should be treated as if they were bare. In arc service the new 100 to 125 light machines have brought about a saving of 40 per cent. where they have replaced 35 to 50 light units.

Referring to alternating arc lamps it is stated that the humming noise may be partially eliminated by using a special transformer made for arc service only. A special arc transformer on the market is mentioned that will feed a steady current through the ordinary $7 carbons, thus dispensing with $20 and $30 cored carbons, and give an equally good service without the use of resistances or economy coils. Central-station men are advised that where there is an alternating plant it is economical to use alternating arcs until the number exceeds 40, when it will pay to put in a direct-current arc system.

The paper sums up as follows :

First. If the money available will permit, direct-connected apparatus should be bought. Second. If the present arrangement of power suggests the purchase of belt-driven dynamos, the heaviest, slowest-speed machine of the largest capacity practicable should be purchased. Third. The plant should be maintained at its highest mechanical efficiency. Fourth. If the power-service is in small motors, none of which is larger than 50-hp, a multiphase system should be used. Fifth. If the proportion of lights is greater than power, high-frequency apparatus should be bought; if power is the most important service, a low frequency should be adopted. Sixth. The largest transformer practicable having the best regulation consistent with minimum loss on no load should be used. Seventh. All current should be sold by meter, and the station output checked with receipts. Eighth. Two and one half watt lamps should be used, or lamps of two-watt if they can be bought.

Arnold Electric Power Station System.

In a paper read before the recent Milwaukee meeting of the Northwestern Electrical Association, the central station of the Fort Dodge Light & Power Company, Fort Dodge, Ia., was described by its superintendent, Mr. E. R. Cunningham. This station is of particular interest for the reason that it was the first plant built according to the system of Mr. Arnold, which was described in our columns when first placed before the public. The plant was started July 1, 1895, and has been in successful operation ever since, without any expense for repairs as far as relates to the system itself.

The advantages claimed for the system installed at Fort Dodge are that it combines a low first cost of a direct-connected or direct-belted plant with the flexibility of speed of large engine-belted plants. The cost per kilowatt and the operating expenses are less, less real estate is occupied, and there is greater ease in handling and less power needed than is usual in other types of plants. All of the bearings are so arranged that a box can be removed and a new one substituted within a very short time, and there being but three sizes of bearings, but one extra piece need be carried, and the necessity of shutting down on account of bearings is reduced to a minimum.

Fig. 1 is the plan view of the Fort Dodge station, showing the method of increasing the plant (the dotted lines showing the machinery to be installed in the future), and also giving a sectional

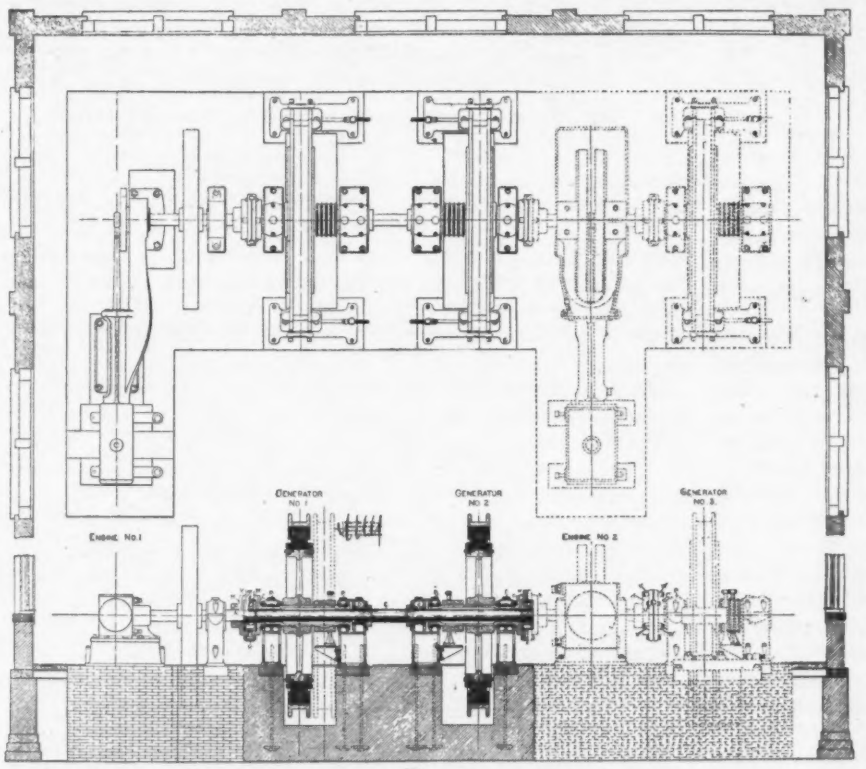


FIG. 1.

view of the mechanism. It will be noticed that there are certain arc and incandescent dynamos and foundations for others, shown in the several illustrations, which ordinarily would not be in a station built in accordance with the plans of the designer; but they are necessary in this case, owing to the fact that we owned an old electric plant, and that in order to utilize as much as possible of the old machinery, an auxiliary shaft was installed in the plant from which the old dynamos are driven. Referring to the sectional view shown in Fig. 1, *C c* are hollow cast-iron quills or shafts mounted in bearings, *P p*, and carrying the armatures of generators Nos. 1 and 2, respectively. *E* is a steel shaft carried in bearings, *D d*, and extending each way from these bearings to the engine shafts, *A a*, and carrying upon its end discs, *F f*, securely keyed to the ends of the shaft. The quills, being carried in independent bearings, do not touch the shaft, *E*, but clear the shaft one half inch all around. On the ends of the engine shafts, securely keyed thereto, are discs, *H h*, corresponding with the ends of the quills, *C c*, already described. These discs or couplings and the ends of the armature quills do not touch discs, *F f*, but have a clearance of one half inch in all directions, thus allowing shaft, *E*, with its discs, *F f*, to lie idle or passive in bearings, *D d*, while the quills revolve around it. When operating under normal conditions, engine No. 1 drives generator No. 1 directly coupled as follows: Three rectangular steel keys are inserted in slots, *U*, spaced 120 degrees apart, and secured in place by suitable bolts, thus coupling disc, *H*, directly to quill, *C*, by means of these keys, but in no manner making connection with disc, *F*.

It will thus be seen that the engine will operate generator No. 1 and not revolve shaft *E*. In a like manner engine No. 2 can be directly coupled to generators No. 2 and No. 3, so that there will be one small direct-coupled unit of one third the capacity of the plant and one large direct-coupled unit of two thirds the capacity of the plant always available without revolving any shafting or having any more wearing parts than in an ordinary direct-coupled plant. Now suppose it is desired to couple generator No. 2 to engine No. 1, owing to generator No. 1 becoming disabled or for other reasons. To accomplish this it is only necessary to remove the three steel keys, *U*, and insert them in slots *V*, spaced 120 degrees apart, the keys being secured in place by suitable bolts. In this manner quill *C* is released from disc *H*, and disc *H* coupled to disc *F*, which will cause shaft *E* to revolve when engine No. 1 revolves. If now there are inserted three additional steel keys in slots *W*, the effect will be to couple disc *f* to quill *c*, thus rigidly connecting the armature of generator No. 2 to the shaft of engine No. 1. Now remove keys from slots *u*. By starting up engine No. 1, generator No. 2 is driven directly coupled from it through the quill of generator No. 1, which is now standing still. In case it is desired to also drive generator No. 1 at the same time, it is done by inserting the keys in slots *U*, thus driving both generators from engine No. 1, and by similar connections with engine No 2 any one or all of the generators can be driven from engine No. 2.

Thus either one or all of the generators are available from the large engine unit, and two of them available from the small engine unit; thus making it possible for a direct-coupled plant with but two engines and three generators to have the same flexibility as an ordinary direct-coupled plant with three engines and three generators, and at the same time saving the difference in cost between three small engines in one case, and two engines, one large one and one small one, equivalent to the three small ones, in the other case. By this method a saving in cost of foundations, cost of engines, and cost of labor, fuel and oil to operate the plant is effected. If engine No. 1 were a compound engine, as would ordinarily be installed, and made sufficiently strong to allow high-pressure steam to be worked in the low-pressure cylinder, we would be able to drive generators No. 1 and No. 2 direct from engine No. 1 up to their full capacity, in case engine No. 2 should be disabled from any cause. The method described of connecting the machines by means of mechanical clutches is only applicable when sufficient time is allowed to permit stopping the machines for making the necessary connection, as in ordinary lighting plants, which operate about 12 hours a day. In case the engines and generators are operated continuously an electromagnetic clutch system has been designed, shown in Fig. 2, which permits coupling the generators and engines when running at full speed. Referring to Fig. 2, shaft *E* carries on its ends discs, *F f*, similar to the one above described. These discs carry wrought-iron rings or armatures, *L l*, *G g*, which are secured to the discs by round gudgeons or studs. The circular rings are held against the discs by coil-springs surrounding these gudgeons, so that when the rings are not attracted by the passage of current through the coils to be described hereafter, they remain compressed against the discs *F f* and do not touch the discs *H J*, *h j*. The discs *H h*, which are secured to the engine shafts, carry also circular wrought-iron discs *I i*, which are attracted by coils *M m* when necessary. Coils *M m*, *O o* and *N n*, are of copper wire wound in recesses and suitably arranged by means of brushes *K k* and *Q q*, whereby current can be passed through them so as to attract the circular rings or armature mentioned when necessary for coupling up. By means of the magnetic clutch, when current is passed through the coil *M*, the disc *I* is attracted, which positively connects the disc *H* to disc *J*, dynamo No. 1 being thereby driven from engine No. 1 without revolving shaft *E*, and in like manner engine No. 2 can be made to drive dynamo No. 2.

In case dynamo No. 1 becomes disabled and it becomes desirable to couple dynamo No. 2 to engine No. 1 and shut down dynamo No. 1, current is passed through the coil *O*, which attracts the armature *G*, thus coupling engine shaft *A* to shaft *E* through disc *F*. Current is now passed through the field and armature of dynamo No. 2 in such a manner as to make an electric motor of it, and when it reaches the same speed as engine No. 1, shown by a suitable indicator, current is passed through coil *n*, thus attracting circular armature *g* and coupling disc *f* to disc *j*, or securely connecting shaft *E* to the armature of generator No. 2. The generator No. 2 is now being driven directly from engine No. 1, and if the current is cut off from the coil *M*, the armature of dynamo No. 1 is disconnected, allowing it to come to rest. In a similar manner dynamo No. 1 can be coupled to engine No. 2 or either generator, or both generators

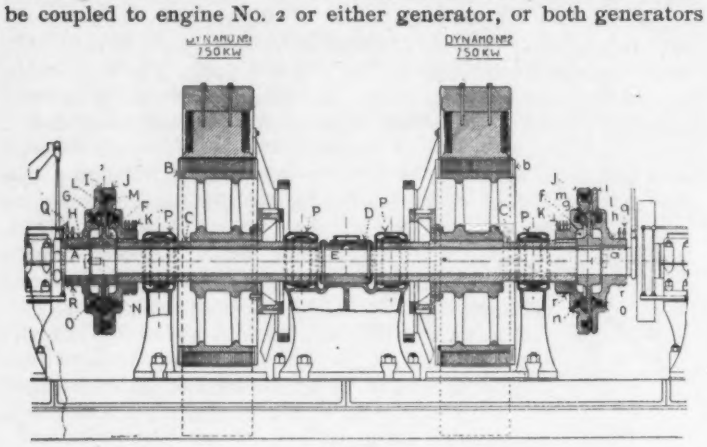


Fig. 2.

can be coupled to either engine, thus making an absolutely flexible direct-coupled plant, and by using compound engines so designed that steam can be worked in the low-pressure cylinders, both generators can be driven to the maximum capacity from either engine and one engine allowed to stand still for repairs.

Another important feature of the system is the fact that any standard make of dynamos and engines can be utilized, thus necessitating no radical departure from the present lines of manufacture. For this reason many of the present plants can be rebuilt to conform to this system, utilizing a large part of their old equipment. Thus, at Fort Dodge, there were two high-speed engines and four T.-H. arc light machines. The engines were not very efficient, being of the common slide-valve type. They would not bring much on the market, and not wishing to throw them away an auxiliary shaft was installed. At either end of this auxiliary shaft was installed one of the old high-speed engines, to be used only in case of emergency. Upon this auxiliary shaft are placed friction clutch pulleys, which are belted to the old T.-H. arc machines. It will thus be seen that power from any one or all of the four engines is available for any one or all of the seven machines thus far installed. This makes the question of a breakdown practically impossible.

This system is subject to various applications, Fig. 3 representing its adaptation to an electric lighting plant operating alternating and arc lights. It will be noticed that this plant has four alternating generators and four arc light generators, all running at the same speed. Each armature is carried on a quill in independent bearings of its own, and arranged to be connected to the shaft by means of magnetic or positive jaw clutches as desired. The shaft is separated in the middle, so that either portion can be shut down while the other is in operation, and on each end is placed a steam engine of some

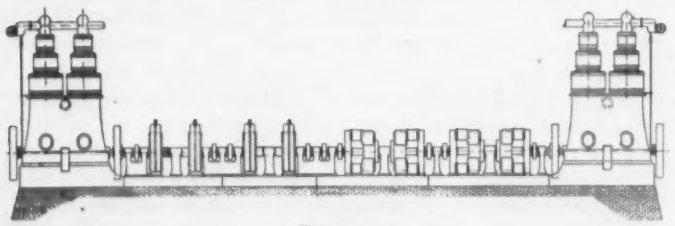


Fig. 3.

improved form. With such an arrangement it is possible to start and stop any generator of the plant without stopping either engine. The dynamos being brought up to speed as motors, the clutches which connect them to the driving shaft are then thrown in, and by means of suitable switches the machines are converted into generators, and then can be cut in on the line for active service. The system comprises numerous electrical devices for controlling the speed of these machines, and otherwise making the plant easy to handle.

Fig. 4 shows the design used for isolated plants in office buildings and apartment houses. In this case one of the engines may be a steam engine which can be used for operating the lights of the building through the Winter months, the exhaust steam being used for

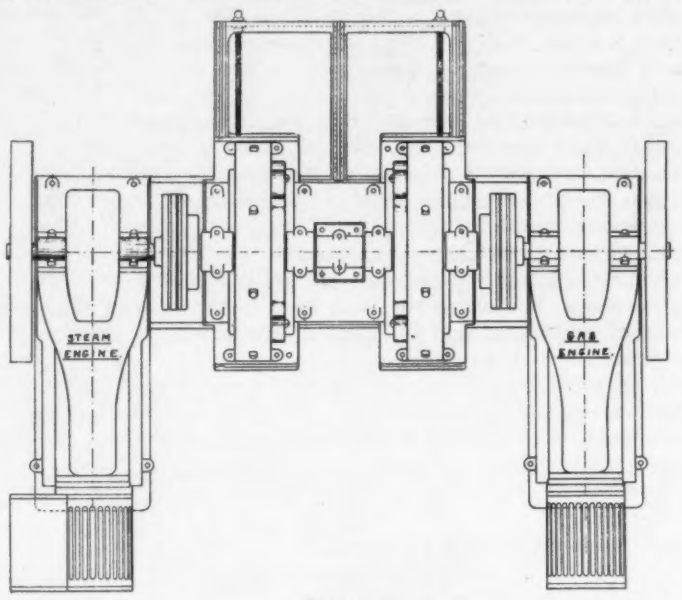


Fig. 4.

heating the building, while in the Summer months the lights are driven from a gas engine located on the other end of the shaft, and the steam plant allowed to stand idle. The result is a great reduction in the cost of labor during the Summer months, and at the same time it is possible to have practically a duplicate plant with but a single investment, as either generator can be operated from either engine.

Mr. Cunningham in conclusion said that the consumers being assured of constant uninterrupted service, have been willing to pay a first-class price to have their buildings properly wired. They have also been willing to pay for the best material and have the work done according to insurance rules and the best modern practice. He offers as an illustration of how carefully this has been done, the fact that every drop cord has been soldered and taped in every socket and rosette. The value of this, he believes, cannot be overestimated, as in his plant such a thing as a short-circuit is unknown, and the company is not obliged to go to the expense of keeping a trouble man, and the consumer is never out of light.

The Invention of the Electromagnetic Telegraph.

Owing to the transposition of type, the concluding portion of the article by Miss Henry, in our issue of Dec. 21, on "The Invention of the Electromagnetic Telegraph," did not appear in proper order, some of the paragraphs having become misplaced. As the ideas were therefore disconnected, we print below the matter in the order it should have come at the end of the article after the sentence "As a resumé now in closing, I cannot do better than quote Mr. Edward N. Dickerson, the eminent patent lawyer":

Come with me now into a telegraph office, and let us see what we find there. If the line be a short one—say 30 or 40 miles—you will see but one of Henry's spools fixed to a table, having a piece of iron, called an armature, capable of vibrating in front of its poles, and so arranged that when the "spool magnet" attracts it, it will vibrate and strike a sounding bar of sonorous metal, which gives out distinctly the sound of the tap. The "spool" is wound spirally in layers with several hundred feet of fine copper wire, covered with silk in the manner specified by Henry in *Silliman's Journal*. At the other end of the line is a battery, composed of a number of cells in series, called by Henry for distinction an "intensity battery," and the wire circuit is supplied with a simple device, so that it may be opened or closed by the operator's finger. When he closes it a current of electricity flows from the "intensity battery" along the wire and around the coil of the "intensity magnet," and the armature strikes the sounder and gives the signal. The listener hears it, and as the order or the taps progresses, in accordance with pre-arranged artificial code, to express the letters of the alphabet by combinations of successive taps . . . he hears letter after letter tapped out and the message is understood.

Now that apparatus has nothing about it more than was in Hen-

ry's Albany telegraph of 1831 ; nor could it operate if it omitted any one of the inventions singly or together, which were then for the first time combined. It depends entirely upon the discoveries made by Henry before 1831 ; and it could not have existed in the world earlier than those discovered by the use of any means then known to man ; nor since by any other means than those discovered by Henry.

Henry used a bell as a sounder ; they now use a metal bar and sounding box. Henry reversed the battery current, whereby no spring is needed to withdraw the armature for the purpose of vibrating it ; and that is the common custom in English and German telegraphs. Here they generally merely interrupt the circuit and the armature is withdrawn from the magnet by a spring ; although Henry's device is also used here largely, and is essential to the quadruplex instruments.

If, however, the telegraph line is a long one—it may be a 1000 miles or more—then you will see two sets of Henry's spools, and two batteries. One is the "intensity battery and spool" first described, and the coil of fine wire may be and often is several thousand feet long, while the battery is composed of more than 100 cells. The distance being so great, they do not attempt to sent force enough through the intensity-circuit to operate a sounder, but only to open and close the local circuit of Henry's quantity-battery spool ; that circuit consists of a battery of but one or two cells of large surface, and a spool of about 100 feet of coarse wire wound about its core. The intensity-combination opens and closes this quantity circuit, whose armature strikes the sounder just as the intensity-armature itself does on a shorter line. This obvious plan Henry described and exhibited in Princeton to his classes before any magnetic telegraph was ever commercially constructed, or the convenience of such an arrangement had resulted from the great length to which the lines had been stretched.

Let us now consider what would have been the position of Henry in the world if—at a time before his inventions had been so long in public use that he had lost his rights—he had taken a patent for

Firstly. His magnetic spools pure and simple.

Secondly. The combination of a magnetic spool of long fine wire with an "intensity battery," for the purpose of producing a practical magnetic effect at great distances.

Thirdly. The combination with such an apparatus of a quantity battery, operating upon a spool-magnet of coarse and short wire, at a distance from the intensity battery; whereby the great lifting power of the quantity magnet might be controlled by the intensity combination.

And *finally*, the combination of the intensity battery and spool, with a vibrating armature, so arranged as to strike a sounder when the circuit is closed or opened at the sending end, for the purpose of transmitting intelligible messages telegraphically.

All these he might have patented in the United States at any time during several years after his discoveries and inventions were made, and . . . if he had taken such a patent as late as 1837, he would have controlled the telegraph in this country, certainly until 1851; and unless he had been adequately rewarded for his great inventions his term would have been extended till 1858. Imagine the good he would have done to science if the wealth which this would have produced had been poured into his purse.

It must have occurred to him at times, when he saw the fruits of his labors enriching the world, that he might have taken some share of the wealth; but he would not taint with selfishness the generous gift.

Mr. Edward N. Dickerson was one of Henry's pupils in Princeton. I end my story with the closing lines of a letter recently received (of Nov. 18) from the Hon. John P. Stockton, who was also a member of his class:

I cannot answer your letter without expressing to you the great affection as well as admiration I had for your father. He was the most simple-minded searcher after truth in every direction that I ever knew, and I think the most interesting and noblest character that I ever met in all my life.

Electrical Warfare.

To the Editor of The Electrical World:

SIR : I read with much interest in your issue of the 4th inst., an account of "Edison's Plans for War," which, however, to my mind, might fail in practice. If I were commander of 10,000 men, I would take two of the 10,000, leave the rest behind, and dress these two in suits made of metal and with shoes having metallic soles, in order to obtain good electrical contact with the ground ; then I would advance with my army of two men, each armed with a rapid-fire gun, and when within squirting distance of the fort, we would pass through the 20,000-volt electric water-shower uninjured, and capture the fort and the 25 men in it with the army of only two men and two guns.

Against men not thus protected the plan of Mr. Edison might, but for a few practical reasons, prove effective. The resistance of a two-inch stream of water, I find in reference to a text-book, to be but little over 100 ohms per foot, and the resistance of salt water is probably not over 50 ohms per foot of stream. Consequently, with such a stream thrown a distance of 300 feet, and having in circuit the voltage named, a man could receive sufficient current to place him *hors du combat*, provided he possessed some means of confining the water to his person until the current had done its work; otherwise the electricity, rather than pass through the subject's body, might be inclined to escape to earth *via* his dripping clothing and the water falling on the ground in his immediate vicinity. Even were the subject so equipped as to constrain the greater part of the current to pass through his body, a slight defect in insulation with respect to the water on the other side of the nozzle would nullify his efforts to die an electrical death—and it would seem no small matter to insulate against 20,000 volts a sufficient body of water (not counting the pumping apparatus) to defend a fort after the proposed plan.

NEW YORK. ELECTRICIAN.

The Laval Steam Turbine.

To the Editor of The Electrical World:

SIR : In your issue of Dec. 14, in commenting on my paper before the American Society of Mechanical Engineers on "Tests of a 10-Hp De Laval Steam Turbine," I notice that an error has crept into what is otherwise an excellent summary of the practical conclusions to be drawn from the paper. The statement is this : "An important point brought out in the paper is that the starting torque is only about half that at full speed."

An analysis of the data will show that the reverse is nearly true—the starting torque being much larger than the torque at full speed. Thus, when the engine develops 10 hp at 2000 revolutions per minute, the torque in pounds acting upon a radius of one foot, will be

$$\frac{33{,}000 \times 10}{2 \times 3.14 \times 2400} = 21.89,$$

while the starting torque under practically the same conditions of pressure, and with the same number of nozzles in action, is shown by Table II. of my paper, to be 30 pounds. Similar comparisons made under different conditions of power give results which are consistent with the foregoing.

LAFAYETTE, IND. W. F. M. GOSS.

[We are glad to have attention called to the important error mentioned, which was due to a wrong deduction from the table given.—ED.]

Storage Batteries for Telephonic Service.

To the Editor of The Electrical World:

SIR : I wish to take exception to a criticism in the editorial in the WORLD of the 11th inst., upon the use of storage batteries in telephone service when located at the subscriber's station and charged when the line is idle.

You predict sulphating as a result of a low rate of charge. The rate at which a cell is charged is not the only point to be considered—the area of plate surface in the cell is equally important. By useing a suitable type and properly proportioning the size and number of plates to the rates of the charge and discharge, sulphating from the cause you mention may be entirely avoided As the service specified requires but little capacity from the cells, a small area of plate surface is sufficient and a correspondingly low rate of charge produces the necessary chemical actions.

About a year ago accumulators to a very considerable number were installed to replace primary batteries in a service corresponding very closely with that called for from cells at subscriber's stations. By protecting the surface of the solution, evaporation was reduced to an extent that was practically negligible, and the cells were inspected only at intervals of three months. Entirely satisfactory results have been obtained, and a recent examination of the plates showed them to be free from sulphate and in excellent condition.

NEW YORK. CHARLES BLIZARD.

A Medical Oscillator.

The newspaper press contains accounts, more or less lengthy, of a new invention ascribed to Nikola Tesla, who is said to have directed his inventive genius in the direction of producing a machine called an oscillator, having for its object the shaking up of the human system, thereby causing certain physical conditions which will result in healing or helping some ailments. It is added that Mr. Tesla intends making several oscillating machines and placing them in the hands of medical experts for the purpose of having their usefulness positively determined. The oscillator is described as consisting of a platform which produces mechanical vibrations that may be made equivalent to the exercise or shaking up of the system which could be obtained by walking or riding for a long distance.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Graphical Theory of Multiphase Motors. HEYLAND. *Elek. Zeit*, Dec. 26.—A continuation of the discussion with Danielson.

Bicycle Dynamo. L'Energie Elec., Jan. 1.—An illustration of an ordinary bicycle, the front wheel of which is fixed and the rear wheel supported free from the ground and belted directly to a dynamo; it is said that from five to seven amperes at 20 volts, that is 100 to 140 watts, can thus be generated continuously for several hours a day.

Selecting an Electric Motor. ZAHN. *West. Elec.*, Jan. 18.—He discusses various points which should be considered in the selection of a motor; it should be noted at what load a motor commences to spark, at what load the temperature rises abnormally, what the efficiency is at different loads and at what speed it runs; regarding the efficiency at different loads he points out the importance of considering whether the motor is to be run generally at full load or at less than its full load; in the former case the efficiency curve should have its maximum at full load, and in the latter at about the usual load at which it is to be run.

LIGHTS AND LIGHTING.

True Resistance of the Arc. S. P. THOMPSON. Lond. *Elec. Rev.*, Jan. 3.—He replies in some detail to the statements of Ayrton, which were abstracted in the *Digest*, Jan. 11. He reproduces the original curve of Ayrton and Perry, as also seven others from various authorities, and shows that the approximate formula, which he (Thompson) gave, agrees much more nearly with the curve than the new formula of Mrs. Ayrton, for which such great accuracy has been justly claimed; the curves for the other determinations, which were more recent, all agree in the main feature of pointing toward an initial value of a little less than 40 volts, while the Ayrton and Perry curve points to about 63 volts. He discusses the facts that are represented by the curves and the equations, and states that his formula, as well as that of Mrs. Ayrton, for a given current, holds good as far as the arc remains stable, but cease for arcs, less than about 1 mm, at which they begin to hiss; he states that the meaning of the curves is that the voltage of the arc consists of a fixed part, which is independent of the length and another which is proportional to the length; the former resembles the E. M. F. in accumulators and motors, and which may be correctly regarded as a back E. M. F., while the latter is simply that used in a conductor; he believes that one violates no principle of physical or logical significance in saying that the normal arc acts as though it offered a fixed back E. M. F. of about 39 volts, and a true resistance proportional to its length. He describes again the experiments in which the voltage along the arc was determined by means of an exploring electrode, in the form of a piece of carbon filament from an incandescent lamp, which was held in different parts of the arc; with a 10-ampere arc, the potential rose about two volts per mm, while at the positive crater there is a sudden jump of about 39 or 40 volts, showing that at the crater there is something of a wholly different nature from a simple resistance; the experiments show that the arc has a true resistance and also something more than a mere resistance, which is located at the crater surface. He ridicules the "startling discovery" of Ayrton of a negative resistance in the arc.

Holophone Globes. GUILBERT. *L'Eclairage Elec.*, Dec. 21.—Continuation of the article mentioned in the *Digest*, Dec. 28; he gives the theory of the construction of these globes.

The Incandescent Lamp Question in Germany. Lond. *Elec.*, Jan. 3.—A translation from the German of the article mentioned in the *Digest*, Dec. 28.

Insulation and Testing of Arc Circuits. DOW. *Elec. Eng'ing*, January.—He discusses the insulation resistance and the practical tests required with circuits of 100 arc lamps in series, the conductor being waterproof wire on glass insulators. He calls attention to the difference between leakage on a series-circuit and one on a parallel-circuit, showing that the stress on the insulation of the wire becomes less as the distance from the dynamo increases; a series-circuit may be operated without interruption and with no apparent effect on the lighting, when the insulation resistance in ohms is numerically less than the working pressure in volts, but how much less he does not state; the essential conditions are that the leaks shall be individually of high resistance, although they may be numerous enough to make their joint resistance low; and they should be distributed uniformally along the circuit; no lights will go out unless there are two grounded points; parallel-circuits, usually with alternating currents of 1000 volts, require better insulation than series-circuits of 2500 or 3000 volts on the same poles. Testing for insulation and locating faults may be done in two ways; the first is with a high-reading voltmeter taking readings from each pole of the dynamo to earth and calculating the insulation resistance by the well-known formula or locating the fault from them; the other method is to use a shunt connected across the dynamo terminals, then finding the neutral point on the shunt; a convenient shunt for 5000 volts may be made of 120 incandescent lamps of 16 cp and 110 volts; for finding the neutral point a cheap galvanometer connected to earth through a choking coil may be used; for indicating volts the voltmeter method is preferable to the shunt, but for locating them the shunt method is better; no tests at the station will do the work of a good patrolman in anticipating trouble. He does not think the usual type of line construction is permissible for 5000-volt circuits in a wet or foggy climate, but it is sufficiently practical for the average conditions in this country; improvement is needed in lamp-hangers and loop-switches; the next step will be the use of highly insulated cables; china or oil insulators are not satisfactory in the smoke and dust of large cities, although they are better than glass in a wet climate; the last stage of progress will be putting all the circuits underground, as there is no question which is preferable, the first cost is the only thing which keeps companies from putting every wire below the surface; high insulation and perfect operation is possible with 5000 volts and underground conductors.

Edison Electric Illuminating Company of New York. WETZLER. *Elec. Eng.*, Jan. 8.—A long, well-illustrated description.

Alternating-Current Arc. FLEMING and PETAVAL. *El'ty*, Jan. 8.—A reprint in abstract of the article abstracted in the *Digest*, Jan. 11.

POWER AND HEAT.

Direct-Driven Tools. TEICHMUELLER. *Elek. Zeit.*, Dec. 26.—In a continuation of the description of the Carlsruhe Exhibition he gives illustrated descriptions of a number of machine tools driven by individual motors.

Electrically-Operated Factories. CROMPTON. *Cassier's Mag.*, January.—He discusses replacing long lines of shafting, pulleys and belts in factories, by motors, giving a summary of the well-known advantages, all of which have already been pointed out in these columns. It is only quite recently that the cost of dynamos and motors has been such that they come in competition with the ordinary lines of shafting; he thinks there are a very large number of factories in which the machinery could be operated far more economically and conveniently than by the older methods, especially when the machines are driven intermittently; the most perfect system would be to provide each machine with its motor, but the high cost of motors makes it better in most cases to use short lines of shafting, which he considers is not as imperfect a method as it might at first appear, as many machine tools are driven continuously in a well-conducted shop; the reduction in cost of small motors is going on at such a rapid rate that it is probable that at no distant time it will be found an advantage to have a motor with each tool. He does not agree with Prof. Kennedy, that if the useful work in a factory is 100 the total indicated horse-power of the steam engine may be made 145; he (Crompton) finds that this proportion is far too favorable and is true only where the load is steady; in most cases he finds that the following figures represent the actual state of affairs; if the average useful work is 100, the average waste in pulleys and shafting is 75, and in engine friction 60, making a total average of 235. He calculates the gain in a certain case for an average of 500 hp and finds that the cost for the electrical method is exactly half that of the other, a large share of which saving is on the labor bill. A further advantage of electric power is that the current can also be used for welding, brazing, soldering and other similar operations, such as annealing and case-hardening. Regarding the best practice in designing the generating plant, he states that experience in England in the last 10 years has shown that the best results in efficiency combined with low first cost has been obtained by the use of high-speed direct-acting engines of the Willans type, coupled directly to 2 or 4 pole dynamos.

Electric Power in Canada. ROBERTSON. *Cass. Mag.*, January.—He gives a brief description of electrical industries in Canada.

Transmission Plant at La Goule. West. Elec., Jan. 18.—A brief, illustrated description of the plant mentioned in the *Digest*, Aug. 31 and Nov. 2.

TRACTION.

Electrolytic Action of Return Currents. GRAY. Lond. *Elec. Rev.*, Jan. 3.—After a brief review of some published papers he gives the suggestions of Mr. Jenkin for two ways in which the potential of the rails can be regulated at the feeder points, one is by adjusting the resistance of the return feeders so that they all have the same drop when equally loaded, and the other is by working the return feeders at the same density, and therefore with a drop depending directly on their length; in the first case the return-feeders are run in parallel at the station from dynamos in parallel, and in the second case they are run from separate dynamos at different voltages, or with some device to vary the voltage; in the second case the feeders are cheaper and require more complicated apparatus at the station, neither method completely gets rid of electrolytic corrosion, as there will always be numerous points near the ends of the feeders where the pipes are positive to the rails. He then describes the Brown system, which has been fully described in these columns, and states that a combination of that with the Jenkin system would lead to an improvement in both, as only the small, stray currents between the ends of the feeders would be collected in the pipes.

Electric Railways in the United Kingdom. Lond. *Elec.*, Jan. 3.—A list of those in operation, in progress and projected.

Electric Propulsion on the Erie Canal. BARNES. *West. Elec.*, Jan. 18.—A reprint of the full text of the report to the State authorities. He refers to the LAMB system which has been fully described in THE ELECTRICAL WORLD and gives the results in tabulated form, of the tests made in October, covering a period of several weeks. The tests were not made under the best conditions, the E. M. F. varied considerably and the power developed by the motor averaged only about one third of its capacity; the results he believes go a long way toward demonstrating that electric towage is feasible, practicable and full of promise in point of economy. The vessel used was a scow; the average speed was 2.5 miles per hour, requiring 8.5 electrical horse-power for the 217.5 tons towed; the price to be paid is not to exceed $20 per hp for the season of navigation, covering about 210 days; from this the cost of a trip from Buffalo to Troy would be less than $5 net, allowing for delays at locks; making a fair allowance, including interest, amortization, rentage of motors, etc., the combined cost would certainly fall far short of the present cost of towage; at $5 per trip the cost is less than 1.4 ct. per boat-mile or 2.1 cts., assuming that the motor is idle one third of the time; these figures can be improved upon under better conditions, so that the above estimate may be considered as a conservative one; the energy consumed would vary about as the cube of the speed, which must be considered if higher speeds are to be used; he considers the results so encouraging that they admit of unusual liberality in making allowances. He compares the system briefly with that tried in 1893, in which a propeller was used on each boat, operated by current from a trolley wire. The tabulated results, including 12 tests of about 10 minutes each, give the readings for every 15 seconds.

Relations Between Stress and Sag in Span and Trolley Wires. MERRILL. *Elec. Ry. Gaz.*, Jan. 4.—He points out the danger of too great tautness in span and trolley wires due to a too zealous attempt to secure the highest grade of construction; he discusses the subject of sag and strains, giving formulas and curves, referring also to some tests made by him (THE ELECTRICAL WORLD, Dec. 4, 1894); he found that for trolley wires the catenary formula may be used; approximate formulas are given for span wires for single and double tracks; he shows that from 3500 down to 1500 pounds for the longer and 800 pounds for the shorter spans, the increase in sag with decreasing strains is very slow, while beyond these points it becomes more rapid. The sag should be made as much as possible consistent with neat appearance while still keeping all parts under moderate tension; all wires should be kept at least 18 feet above the track, and there should always be a factor of safety from 2 to 2.5; at such heights the apparent sag is much less than the actual, a sag of 10 inches in the trolley wire being hardly noticeable, while 15 inches to 2 feet in the span wire are not objectionable; a factor of safety of 2.5 means a stress on the trolley wire of about 1100 pounds; the corresponding strains on the span wires and poles are also given; the reason that some of the best constructed lines are continually breaking is due to great tautness. A table of the sag in span and trolley wires is given. As the strain on a pole is decreased, its stiffness, weight and cost can be decreased; if expansion and contraction are compensated, the conditions of temperature need not be given their full theoretical value; his observation has lead him to believe that under ordinary conditions a sag of 15 to 18 inches is ample, while frequently no attention need be given to temperature further than to see that the trolley wire has a sag of 12 inches if erected in Summer and 6 inches if erected in Winter; the anchorage is very important in considering this compensation; a good system needs but few anchorages, and these should be between the points where movement is free to take place, and not at each end; if too rigidly anchored, a line may be wrecked which would otherwise remain in good alignment.

Electric Railway. HALL. *Elec. Ry. Gaz.*, Jan. 4.—A short article on "A Glance at the Situation," in which he discusses the probable developments of electric railways. He does not believe the new year will bring about any startling developments which will place any new schemes at the head; the sectional system of surface contacts has been successful, experimentally, but he seems to think there is no great future for it, as one failure could disable the whole system; he thinks that the solution of the question of electric traction will never be found in the storage battery; also that any revolution in electric traction will not be along the lines now being followed, but will be due to "an undiscovered trait of the alternating current, or an hitherto unknown function of electrical action." He favors the best construction, and properly instructed motormen; there are two important questions, which present themselves with great urgency, one is to prevent accidents to pedestrians and vehicles, and to meet this the car should be under perfect control, which can only be done by a practical power-brake, the cost of which, even though it might be great, would probably be more than counterbalanced by lessening the number of accidents; the second question is the destruction of water and gas pipe by electrolytic action, for which it is hard to prescribe a cure, although there are several well-known methods of mitigating the trouble, which methods he reviews briefly.

Fuses for Street Railway Cars. *Elec. Ry. Gaz.*, Jan. 4; editorial.—The common practice is to place a single fuse in the trolley circuit to protect both motors, which method, it is claimed, is open to serious criticism; it is shown that a much better method is to place a fuse in the circuit of each motor; after first adopting this method there will be considerable fuse blowing, which would show that cars had previously been imperfectly managed; if the controller is thrown on too quickly the fuse would surely blow, and after a few experiences of this kind a motorman would be more careful and incidentally more economical.

Urban Growth and the Electric Railway. BELL. *St. Ry. Jour.*, January.—He shows the influence which the electric railway has had in Boston in increasing the suburban territory available for business and working men.

Mechanical Traction on Railways. *Elec. Ry. Gaz.*, Jan. 11; a reprint of the article from the Lond. *Elec Rev.* mentioned in the *Digest*, Jan. 4.

Detroit. *St. Ry. Jour.*, January.—A long, well-illustrated description of the Detroit Railway Company's plant.

Brooklyn. *Elec. Ry. Gaz.*, Jan. 4 and 11. An illustrated description of the street railway systems of that city.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electricity in Mining. WALKER. *Elec. Eng.*, Jan. 3.—The first part is historical. Regarding the explosion of mine gas by the electric spark, he states that it is not a mere spark which will ignite gas, but a spark of a certain amount of energy, namely about 20 watts; he made his experiments with ordinary coal gas, but recent experiments of Prof. Lewes show that the gas found in mines is much less inflammable than ordinary coal gas; it is even claimed on the authority of experiments made in Germany that the spark between the broken ends of a live cable will not fire the gaseous mixture as it does not continue long enough. In regard to mining cables, he believes it unwise to protect the cable by an outer conductor, as one then runs great risk of damaging the insulation; the money spent on the outer metal would be much better spent on India rubber protected by jute. Electric transmission is now making steady progress and is gradually pushing out steam, compressed air and rope driving; he states that those who are closely connected with mines believe that electricity will be the salvation of the mine owner, the only difficulty at present being to make the mine owner believe it.

Lamp-Connection Diagrams in England. Lond. *Elec.*, Jan. 3.—Curves are given showing the lamp connections of the London companies for the past five years; the total in London now is 1,178,600 as against 925,100 last year; (this probably refers to 8-cp lamps); diagrams are given showing the lamp connections of London and the Provinces, which latter amount to 1,100,000, while last year it was only 670,000, showing that in the metropolis the increase was only 27 per cent., and in the Provinces 64 per cent.; another comparison shows the number used with alternating and with continuous currents, the former now leading in London but not in the Provinces; in London and the Provinces together the continuous current leads; in another diagram regarding municipal lighting, it shows that the lamp connections of municipal companies lead in the Provinces, but is an almost negligible quantity in London.

Electric Supply Stations of the United Kingdom. Lond. *Elec.*, Jan. 3.—A large annual table, published as a supplement, giving a list of the stations and tabulated data regarding them.

Danger of the Electric Shock. SNELL. Lond. *Elec.*, Jan. 3.—He refers chiefly to his experience with mountain plants; he some years ago decided on 500 volts as the best, considering both the danger limit and the size of the leads; he thought that this was not likely to occasion any serious accidents from shock under working conditions; he refers to some cases where men were shocked, but not injured; however, he does not think that a man could live for many minutes when subjected to 500 volts through good contacts; he thinks it due to the care used in the use of safeguards, rather than to any inherent safety of 500 volts, that accidents are practically unknown in mining plants. He thinks it difficult to answer offhand in the affirmative the question whether 250 volts is likely to be harmless to the ordinary user of electricity; he does not think our present knowledge of the physiological effects warrants drawing a difference between the danger of continuous and alternating currents; he con-

siders the latter to be the least dangerous, on account of the well-known repellent action of the fingers, whereas continuous currents attract them; he favors earthing the middle wire of a three-wire system, at one point, as this is the only way of fixing the maximum pressure on a given system.

Ayr. Lond. *Elec. Eng.*, Jan. 3.—A long, well-illustrated description of this alternating-current, water-power plant of about 200 kw.

Paris. West. Elec., Jan. 11.—A reproduction of some of the illustrations and a portion of the article by Laffargue, mentioned in the *Digest*, Dec. 7; load diagrams are given for one of the stations and for all the stations combined.

ELECTRO-PHYSICS AND MAGNETISM.

Experiments with Electric Discharges. Bordier. *L'Eclairage Elec.*, Dec. 21.—An extract from an Academy paper describing investigations with a sort of brush discharge, which he calls "souffle electrique," and which appears to be a sort of brush discharge, resembling in some respects a puff of air, and which he says is used largely in medical applications of electricity; the conditions for the productions of this phenomenon are not yet well understood, and he therefore made experiments to determine how the surface effected by this discharge and the intensity of the puff or wind vary with the sign, as also to determine the effect of the angle of the cone. To measure the space over which it acts he used paper containing iodide of starch, which the ozone in the discharge discolored, and found that the circular area corresponding to a negative discharge has a smaller diameter but a darker color than for the positive discharge; the discharge is therefore more divergent from the positive than from the negative pole and the density is greater from the negative. For measuring the intensity of the wind he used a sort of pendulum measuring the distance through which it was moved by the mechanical force of the discharge, and finds that the negative wind has a greater intensity than the positive; the difference is sufficiently great that one can tell which is a positive and which is a negative pole of an influence machine by placing the hand or face in front of the point; he finds that the best angle for the point is 90 degrees, and not a sharp point, as is generally supposed.

The Atom and its Charge. J. J. Thomson. Lond. *Elec.*, Jan. 3; a reprint in abstract from the *Phil. Mag.* for December of his paper on "The Relation Between the Atom and the Charge of Electricity Carried by It."—He endeavors to establish the proposition that when charged atoms are close together, there may be forces, partly electrical and partly chemical, in their origin, in addition to those expressed by the ordinary laws of electrostatics; the relationship between pairs of atoms close together is shown to be very different from the ordinary electrostatic behavior of atoms in bulk; the forces between charged atoms close together seem to be modified by their electrochemical properties and therefore, if positively charged, an electro-negative atom cannot, in the absence of a strong external field, interchange its charge with a negative charge on an electropositive atom unless the two are connected by an external conducting circuit; he applies this theorem to the oxidation of zinc by way of illustration; he also investigates the minimum voltage required to produce a spark in a gaseous electrolyte and shows that it is highly probable that this minimum is of the same order as the voltage between the atoms in a single molecule when not surrounded by others which influence its electrostatic condition.

Phase Difference. Puluj. *Zeit. f. Elek.*, Jan. 1; the first part of a mathematical article "On the Phase Difference between the E. M. F., and the Difference of Potential at Branching Points of a Circuit, for Harmonic Alternating Currents."—In the researches of others on the branching of harmonic alternating currents, the difference of potential at the branching points is assumed to be known, and from the resistance and self-induction coefficients of the branches, the relations of the currents in the latter in amount and phase were determined; in the present article he assumes a known total E. M. F., and from it determines the difference of potential at branching points, in amount and phase. He deduces a formula, which shows that the difference of potential at the branching points can either be behind the total E. M. F. in phase, or can be in advance of it, according as the time-constant of the main circuit and the source is greater or smaller than the equivalent time-constants of the branch circuits; if these time-constants are equal, then both E. M. Fs. have the same phase.

Energy of the Current. Gross. *Electrochem. Zeit.*, January.—A continuation of the article, the first part of which was abstracted in the *Digest*, Jan. 5, 1895.

Electricity from Heat. Meyer. *Electrochem. Zeit.*, January.—A detailed description of the principle and the patented device, which was described in the *Digest*, Sept. 21; see also Dec. 28.

Photographing Through Opaque Bodies.—The New York *Sun* publishes a dispatch from London stating that Prof. Routgen has succeeded in photographing rays "of light" (*sic*) which penetrate solid opaque bodies, such as wood, flesh, or other organic substances; the source of rays is said to be a Crooke's vacuum tube through which an electric current is passing; it seems from the brief dispatch that these rays will pass through certain organic substances, and can act on a photographic plate; he has photographed metallic bodies hidden behind a cloth, also the bones of a man's hand, the rays passing through the flesh; he is said to be using the method to photograph broken limbs and bullets in the human body. (If there is any truth in this dispatch, it may be that electromagnetic waves were meant instead of rays of light, and that certain bodies, opaque to light rays, may transmit the electromagnetic rays, while other bodies may reflect or absorb them, thus enabling something analogous to a shadow of the latter kinds of bodies to be photographed, even though they may be surrounded by materials which are opaque to light.)

ELECTRO-CHEMISTRY AND BATTERIES.

Theory of Electrolysis. Bucherer. *Chem. Zeitung.*—A short article in which he shows that by applying his theory (see *Digest*, last week) to the investigation of certain voltaic combinations, interesting relations can be found which the modern hypothesis of charged ions is not capable of explaining. He proves first that the E. M. F. for electrolyzing a salt which crystallizes without a solvent, is independent of the solvent for saturated solutions; supposing for instance that common salt is 100 times as soluble in water as in an alcohol, then the E. M. F. required for decomposing a saturated alcoholic solution is the same as that for decomposing the aqueous solution. But the osmotic pressures of the two solutions are evidently very different, the one being 100 times as large as the other; in order to explain the equality of the E. M. Fs. the modern theory would be obliged to assume that the solution tension of chlorine and of sodium is 100 times as great in H_2O as it is in alcohol; but why is it greater in aqueous solutions than in alcoholic ones the modern theory could never tell; nor could it give a reason why it should be exactly 100 times as great; here is a distinct example of the weakness of the modern theory. So-called fluid chains, in which equally concentrated solutions of silver nitrate in water and alcohol were opposed to each other, according to the arrangement Ag / Ag NO_3 in water / Ag NO_3 in alcohol / Ag, were measured by H. C. Jones, who found that the current went within the chain from the aqueous solution to the alcoholic one, and concludes from the magnitude of the E. M. F. that the solution tension of silver in water is 40 times as great as in alcohol. Nernst, discussing his results, agrees with Jones that the electrolytic solution tension in water is greater than in alcohol. For special cases Bucherer shows that the direction and magnitude of the E. M. Fs. of such chains can be calculated *a priori* when the solubility of the salt in the two solvents is known. For binary electrolytes he finds $E = R\ T\ \log_e \frac{L}{l}$ where L and l signify the solubility in the two solvents for equal volumes. It is further shown how the vapor tension of metals, a physical quantity which the author thinks is destined to play an important part in the future, can be indirectly found from measurements of voltaic E. M. Fs. In conclusion, he urges the need of abandoning the modern hypothesis of electrochemistry as represented by Ostwald, Nernst and Planck. The views, as developed by him, he thinks, have come to stay, and from their general acceptance he expects the discovery of new facts and new laws.

Sulphuric Acid and Sulphates by Electrolysis. Darling. Lond. *Elec. Rev.*, Jan. 3; a short note referring to some recent departures in this direction.—In the manufacture of the acid the mixture of nitrogen, peroxide, and oxygen evolved when fused sodium or potassium nitrate is electrolyzed, is used as a substitute for the nitric acid commonly employed; the decomposing vessel is of cast iron, closed at the top, and having a supply-pipe extending nearly to the bottom; the positive pole consists of a series of cast-iron plates suspended from a cover, the vessel being the negative pole; when the gases cease to pass the current is switched to the next apparatus while the first is being refilled. In another process, which is for the utilization of nitre-cake and acid sulphates, the prevailing idea is to decompose an electrolyte containing a similar base to that of the sulphate with transference of that base to the sulphate; the solution of the nitre-cake is placed in two outer compartments of a three-compartment cell having porous partitions, the middle compartment containing a sodium chloride solution; carbon forms the positive pole, while the negative electrodes in the outer cells may be of sheet lead; sodium chloride is added to the middle cell until the acid sulphate in the outer cells is neutralized, after which the salt is drawn off, filtered and crystallized.

Electro-Chemistry in 1895. Weyer. *Electrochem. Zeit.*, January.—The first part of a brief review, including a large number of references to the original articles; most of the subjects referred to have been more fully treated in the *Digest*.

Maximum Possible Efficiency of Galvanic Batteries. Morton. *El'ty*, Jan. 15.—A reprint of the article abstracted in the *Digest*, June 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Efficiency of Transformers. Korda. *Elek. Zeit.*, Dec. 26.—He describes a method to be used specially for large transformers by means of which it is possible to find their efficiency when sufficient power to run them at full load is not at hand or when it is desired not to waste the power; by the present method all the losses are measured at one time instead of measuring those of the iron and of the copper separately; the method of Sumpner and that of Kapp can be used when there are two identical transformers besides a third auxiliary one, but the present method can be used with only a single transformer and with the aid of an

ampere meter, a voltmeter and a wattmeter, provided connections can be made with different parts of the windings of the coil. Assume that the secondary is closed on itself by connecting the two halves in opposition to each other; the two E. M. Fs. will then neutralize each other and there will therefore be no current; the primary will then take only the amount of current represented by the magnetization and the no-load losses; if the primary current is then regulated so that the voltage between the ends of the halves of the secondary coil is a certain amount then the induction can be calculated from a formula which he gives. It the two halves of the secondary winding have not exactly the same number of turns a current will circulate through them; if therefore it is desired to have a current of a certain value the number of windings in the two halves must bear a certain relation to each other, which he gives; when these currents circulate, the magnetic induction in the iron is the same as it would be for that current when running normally; the iron losses will also be the same, as also the secondary copper loss; the primary current will of course be considerably smaller than under normal conditions; in order that the primary current should be the same as it would be under normal conditions for that secondary current, and therefore that the primary copper losses should be the same, the primary coils are treated similarly to the secondary, that is, a certain number of windings are rendered inactive, so that the transformer ratio remains the same. In a transformer with a closed magnetic circuit the current at no load differs in phase with the secondary current by about 180 degrees; the error in the above method will therefore be quite negligible if certain relations which he gives algebraically exist; a wattmeter in the primary circuit gives by direct reading the total losses of the transformer; the amount of energy consumed is only that required for the total losses.

Alternating-Current Measuring Instruments. BENISCHKE. *Zeit. f. Elek.*, Jan. 1.—He describes briefly and illustrates the principle of volt, ampere, and wattmeters and integrating meters, based on the same principle as that of his motor which was described and illustrated in the *Digest*, July 6. He gives briefly the theory, and shows that the torque is proportional to the square of the current, that is, to the effective current; also that it is approximately independent of the different frequencies occurring in practice; the torque is opposed by a spiral spring to make a deflecting instrument; for the integrating meters the number of revolutions is recorded in the usual way. For an integrating wattmeter the coils carrying the main current are over the fixed segments and do not project over the edge; the fine wire coils are only over the revolving plate.

Direct Reading Platinum Thermometer. APPLEYARD. *Phil. Mag.*, January.—A reprint in full, with illustrations, of the paper abstracted in the *Digest*, Dec. 28.

Fine Wire Thermo-Cells. CZERMAK. *Elek. Zeit.*, Dec. 26; abstracted from *Wied Ann.*, Vol. 56, p. 352.—He describes their application for measuring temperatures in meteorology, especially for momentary temperatures; such instruments have given very good results; thermo-cells of wires 0.1 mm in diameter and 2 or 3 cm long take the temperature with astonishing rapidity; when covered with lamp black they may be used for radiated heat; it is easy to read one-hundredth of a degree; several different forms are briefly described in the abstract, as also the galvanometer.

Permeameter. HELMER. *L'Elec.*, Jan. 4.—A well-illustrated description, including all the dimensions, of a permeameter which he has used. He tried the Thompson form with a frame of large section, but found that the force required was not always the same for the same number of ampere-turns, in spite of the precautions taken to have a good contact, and he attributed the differences to the small cross-section of the sample, that is, the usual apparatus was too small, and he therefore constructed a very large one in order to increase the cross-section of the contact, while still retaining a large ratio between the diameter and the length of the sample core; in his apparatus the length of the core is 42 times its diameter. There is a coarse wire solenoid for measuring the permeabilities by the method based on the pull exerted, and there is also a small fine solenoid at the middle of the other for making measurements by means of the ballistic method, in which the magnetic flux is reversed. The theory and some of the results of experiments are given.

Measuring High Temperatures. HOLBORN and WIEN. *Elek. Zeit.*, Dec. 26; abstracted briefly from *Wied. Ann.*, Vol. 56, p. 360.—They discuss the constancy of thermo-cells under different external conditions, the dependence on the resistance of platinum metals at different temperatures and the construction of air thermometers for very high temperatures. In general, with the different thermo-cells an accuracy of 5 degrees in 1000 can be depended on, but with single cells a much greater accuracy may be reached; they do not change in the course of time whether they are used or not. A large amount of platinum and platinum-rhodium wire was obtained and accurate measurements made, the results of which are given, and may be used for all cells made from that lot of wire. Carbon has a bad effect on the constancy of the E. M. F. of thermo-cells, and they must therefore be protected from it; platinum-silicum, on the other hand, has no appreciable effect. The melting points of the various refractory metals are given. Regarding the changes of resistance in the platinum metals of different temperatures, they concluded that it is less adapted for temperature measurements than the above-mentioned cell; the constancy of the resistance cannot be relied upon, and the calibration at high temperatures must be made by comparison with other instruments.

Water-Battery. AUSTIN and THWING. *Elec. Rev.*, Jan. 15.—A reprint with the illustration of the article abstracted in the *Digest* last week.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Induction in Telegraph and Telephone Lines. MUENCH. *Elek. Zeit.*, Dec. 12; reprint of a paper.—He gives the experience of the German government telegraph department. There are two kinds of distributing currents, those due to differences of potential at the earth-plates, and those due to induction; the former are avoided by using metallic circuits, which are the only systems discussed. Numerous devices have been suggested for avoiding the induction cross-talk, most of which have in practice given good results, but they are not a complete solution of the problem, as they involve difficulties; the method of running four wires of two loops on one pole and crossing them in the well-known way is discussed, and the experiences of that department are given, from which he draws the following conclusions for telephone-circuits: Two loop circuits on the same pole are free from induction for all lengths occuring in practice, if the distance between them is 50 cm (about 20 inches); an additional circuit on the same poles will be free from induction if its distance from the nearest one of the others is 50 cm; when there are a number of loops on the same poles the distances between them may be made less. The rest of the paper is devoted to a discussion of the suggestion made some time ago that there will be no cross-talk if the iron supports for the insulators of the two wires belonging to the same loop are connected together electrically, as it is thought that those points of the loop will then have the same potential; to test this theory a number of experiments were made and are described, yielding negative results.

Block Telegraph System. PIGG. Lond. *Elec. Eng.*, Jan. 3.—He points out some of the weak points in the system.

Telephone-Tower in Bruenn. BIEGLER. *Zeit. f. Elec.*, Jan. 1.—The first part of an illustrated description.

Machine Telegraphy. DELANY. *Jour. Frank. Inst.*, January.—A brief, illustrated description of his system, which was referred to in the *Digest*, Sept. 7, 14 and 28 and Oct. 12. After describing briefly the limitations of the other rapid systems and showing that electrolysis seems the only means to be used for still greater speeds, he gives a brief, illustrated description of his apparatus. The perforator for preparing the band which passes through the machine has three keys, one for a dot, one for a dash and another for the space; the punches are operated by electromagnets; the ribbon is perforated in two lines, the upper one representing dots and the lower dashes; the letters are all made of dots and dashes according to the continental code, that is, without different lengths of dashes and spaces. The transmitter consists of a paper-moving device, and two pairs of wire brushes pressing toward each other, one above and the other below the tape; the top brushes are both connected to line and the bottom ones to the two ends of the battery, the middle point of which is grounded; the paper separates the brushes, which come in contact wherever there is a hole; when the hole is on the lower line a negative current is sent to line representing a dash, and whenever it is in the upper line it represents a dot, and a positive current is sent to line; no dashes are sent, they being indicated by their position on the tape, as all the impulses are of uniform duration, the line being therefore no more heavily charged at one time than another, for which reason the discharge is uniform and the signals, as received, are very regular. In the receiver a tape passes under three thin iron wires, the two outside of which are electrically one and are connected to earth while the middle is connected to the line; the paper is moistened and is chemically prepared; for a dash the current is forked or divided on the receiving tape, and all dashes are therefore in the form of double dots, while the dots proper are single and occupy the centre line on the tape; the dots and dashes are therefore all of equal length, but are distinguished by the fact that the latter are double dots, one on either side of the middle line; in this way, no matter how bad the tailing, it is impossible to mistake a dot for a dash, nor is it necessary to have a division between successive dots and dashes, as the length of the mark determines at once the number of distinctive marks intended.

Communication Between Moving Trains. Elec. Age, Jan. 11.—A reprint of the description of the DE LA TOUCHE system mentioned in the *Digest*, Jan. 4.

Cable Repairing Ships. HEINSOHN. *Ind. Rub. World*, Jan. 10.—A short illustrated article.

MISCELLANEOUS.

The Past Year. Lond. *Elec.*, Jan. 3.—A brief editorial review of the past year, much of which is only of local interest. Among other things it states that there has been a marked tendency to combine an alternating system for outlying districts with a continuous-current for the central area, motor-alternators being usually employed; rectification of alternating-currents for street arc-lights is finding great favor, as photometric measurements make it "evident to all unbiassed persons that the alternating-current arc can scarcely hold its own against good modern gas lighting, not to mention its more regular electrical rival." Dust destructors bid fair to become an integral feature in all "fashionable" English municipal central-stations; the adoption of the Wright system of

charging (which has been fully explained in these columns) is becoming more general in the provinces. There have been two serious fires at London stations and another at a small provincial station, showing the importance of more attention to fire-proof construction, "it will never do for the English electric-light stations to earn the bad name their American congeners have acquired for this." The road on the Isle of Man and the one from Bristol to Kingswood represent all that was done in electric traction; the Central London Railway (underground) has been commenced, and the Waterloo & City tunnel is progressing; a future for electric traction is predicted. There has not been much technical advance in telephony; it is proposed to make considerable use of the telephone in place of the telegraph to avoid the expense of skilled operators. He believes that there has been something in the nature of a lull in the scientific electrical world as well as in the engineering electrical world; electromagnetic waves are becoming more manageable in size and more analogous in their behavior to the so-called light waves.

Electricity and Vegetation. Lond. *Elec.*, Jan. 3; a brief extract from *Nature*.—Bonnier found that continuous electric light promotes the formation of chlorophyll and also brings about a simpler anatomical structure of the leaves; the distribution of the chlorophyll is more extended; the palisade tissue of the leaf is reduced or disappears and the epidermal cell walls are thinner; the bark is less developed and the tissues of the stem less differentiated; Alpine plants, under continuous electric light, exhibits identical structure with those of Arctic plants, which are exposed to almost continuous sunlight in the summer. Prof. Aloi deduces evidence in favor of his view that both terrestrial and atmospheric electricity exercise a favorable influence on the generation of seeds and on the growth of plants, and predicts that the employment of electricity will be a most important factor in the agriculture of the future.

British Electrical Patents Expiring in the Present Year. Lond. *Elec.*, Jan. 3.—A list of the patents which will expire if they have not already been allowed to lapse.

Calcic Carbide Plant at Niagara Falls. Dunlap. *West. Elec.*, Jan. 18.—A short article on this plant, which it is thought will be started in February and which is the first of its kind in America. The contract calls for 1000 hp; an alternating-current furnace is to be used and the current is all of one phase, at about 100 volts; four furnaces have been built, each containing cast-iron crucibles 3 ft. 6 in. long, 2 ft. 8 in. deep and 2 ft. 2 in. wide; the current will be kept on for three hours, one furnace being operated at a time; each hp is supposed to give 20 lbs. of carbide per 24 hours and each pound is supposed to produce over 5 cb. ft. of acetylene gas; it is thought that the cost of manufacture will not exceed five dollars per ton. He adds that if the total 100,000 hp available at the present Niagara plant would be used to produce the carbide, the gas from it, considering the greater lighting power, equals if not exceeds the total output of coal gas in the United States.

In connection with the subject of calcium carbide and acetylene, attention may be called to a number of editorial articles and communications which for some weeks have been appearing in the *Eng. & Min. Jour.*, most of which are intended to caution prospective investors to be careful, as it is claimed that there can be no monopoly in this country.

Electricity in 1895. Martin. *Cassier's Mag.*, January.—A review, in popular language, of what has been done in the past year.

New Book.

Modern Copper Smelting. By Edward Dyer Peters, Jr. Seventh edition, rewritten and greatly enlarged. New York: The Scientific Publishing Company. Price, $5.

This handsomely printed book has now appeared in its seventh edition, a fact which shows its great value and popularity. The rapid and extraordinary development made in the metallurgy and refining of copper is thoroughly reviewed in this work, with special reference to the establishment and practical working of plants. The author describes the methods and apparatus for smelting and refining copper, mostly from facts gathered from his own experience, and with the valuable assistance of specialists employed in such works, both in this country and abroad. These contributions from specialists make the book the more valuable, while details of constructions, costs and results are described by the author which are either not given complete in similar works or have partly been carefully guarded from the public and therefore were not accessible. The working drawings and plates are numerous and of great clearness.

A special chapter on the electrolytic refining of pig copper makes the book a very desirable acquisition, not only to professionals in copper refining works, but to electricians in general. The processes of electrolytic refining, that is, "multiple arc" and the "series," have been carefully compared by the author, less from the theoretical than from the practical standpoint, and the question of the relative value of the two systems are minutely reviewed and careful data given. Special pains are taken to consider all sources of possible disturbances and losses in the working of plants, and it is shown under what conditions the highest efficiency can be maintained. For erecting new works valuable information is given as to the selection of the most desirable apparatus and machinery, and all requisites necessary for successful operation, from the steam engine and electric generator, down to the tanks, and anodes, and cathodes, and the method of supporting the latter in the tanks. Exact data are given as to the size of all apparatus, and the electrical conditions for obtaining the highest efficiency are carefully noted. All operations in every phase of the process are described, and the exact cost of operation and production are given in detail, which otherwise can only be obtained from specialists in this line. These data compiled in one work certainly make the book extremely valuable.

A New Safety Device for Steam Engines.

A simple and effective device designed to prevent accidents has recently been patented by Mr. A. K. Bonta, chief engineer of the North

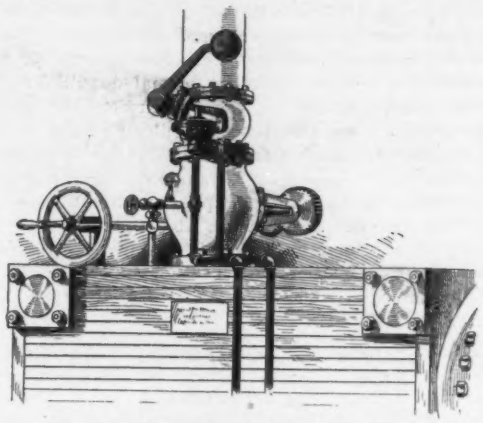


Fig. 1.—Arrangement at Throttle.

Hudson County Railway Company, of Hoboken, N. J. The arrangement consists of a system of air pipes about the engines and provided with glass air tubes, which, when broken, allow the compressed air to escape

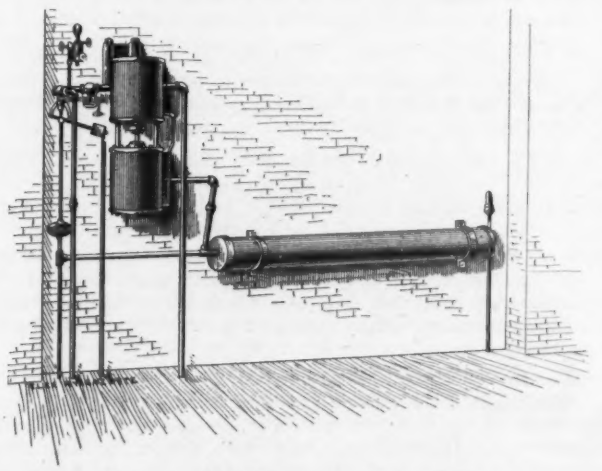


Fig. 2.—Air Pump and Reservoir.

from the pipe, thereby putting in action a weighted lever, which closes a butterfly-valve.

The power plant in which this system is employed contains two horizontal and two vertical cross-compound condensing engines. Each engine is provided with a butterfly-valve, which is attached to the live steam pipe above the regular throttle, and so weighted as to tend naturally to close; it is normally held open by compressed air. (See Fig. 1.)

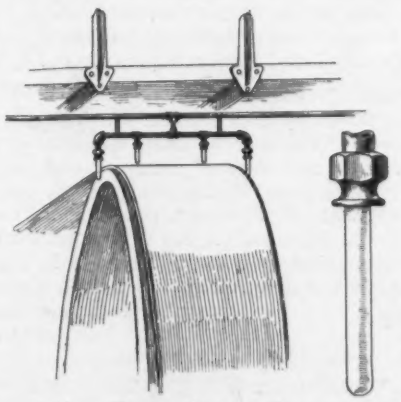


Fig. 3.—Air Tubes About Engine Pulley.

The air pump and reservoir are shown in Fig. 2. The pump is of the Westinghouse air-brake type, and automatically maintains a pressure of 48 pounds to the square inch in the air tank and pipes. The reservoir is of wrought-iron pipe, 6 inches in diameter and 8 feet in length. A double system of piping extends from the reservoir to each of the engines, and is connected to the automatic shut-off valves.

The glass air tubes are attached to the pipes as shown in Fig. 3. Two of the tubes are located near the edges of the fly-wheel, and two are secured to the air pipe directly above, and about one inch distant from the face of the fly-wheel. It will be seen that in case the belt should break, or a flap become loose, or if it should creep over the edge of the fly-wheel, one or more of the air tubes would be broken and the air be allowed to escape from the pipe, and the valve lever, then no longer held up by the pressure of the air, will instantly close and shut off the steam. At the same instant an automatic valve attached to the exhaust steam pipe, as shown in Fig. 4, is opened and the vacuum destroyed. The engine will also be equipped with the device provided with governor-balls, which, as the speed of the engine increases, will fly out by centrifugal force and at a predetermined speed come in contact with and break one of the glass tubes, thus preventing danger from racing.

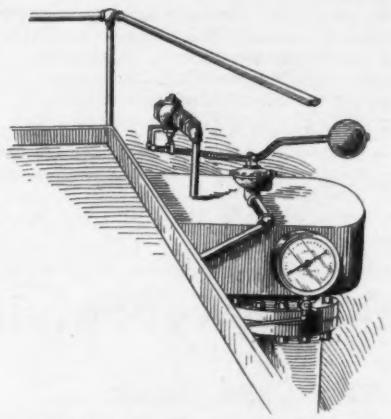


FIG. 4.—AUTOMATIC VALVE ON EXHAUST PIPE.

All the engine throttles are supplied with compressed air from one system of piping, but the breaking of an air tube on one engine releases the air pressure at the throttle of that engine only, the fall of the throttle lever closing a cock in the air-supply pipe so as to prevent leakage of air at that point, which would, of course, result in shutting down all the other engines.

FIG. 3.—COMBINED VOLT- AND AMPERE-METER.

The air pipes extend through the engine-room and office and the generator-room, and are provided with plug-cocks so distributed as to be within reach of the attendant in any part of the plant. Each pipe bears the number of the engine to which it is connected. The device is simple and not expensive in first cost, and when installed the cost of maintenance is very slight.

Dynamo and Combined Volt- and Ampere-Meter.

The dynamo and combined volt- and ampere-meter shown in the accompanying illustrations were designed by Messrs. Amstutz and Lincoln for the Institution for Home Study of Engineering, of Cleveland, O., as an equipment of electrical apparatus for its students and for schools and colleges generally. Fig. 1 shows a 250-watt dynamo complete and connected as a four-pole shunt-wound direct current machine operating with four brushes. The other represents the machine as it is received by the students of the Institute who are pursuing the electrical course.

It will be noticed that there is a set screw in the head of the commutator bar. This is for conveniently changing the connection of the coils. There are twenty-five changes, each one making a different machine—of course in principle chiefly, as the same armature and field are used in them all—fifteen being as direct current and ten as alternate current machines. For alternating current work collector rings, which can conveniently be slipped on and off the commutator, are furnished. The machine does not have to be separately excited when running as an alternator, means having been provided for self-excitation. The upright piece of both illustrations is a foot rule by which the size of the parts can be determined. This is not only an experimental, but a commercial machine, being well made throughout.

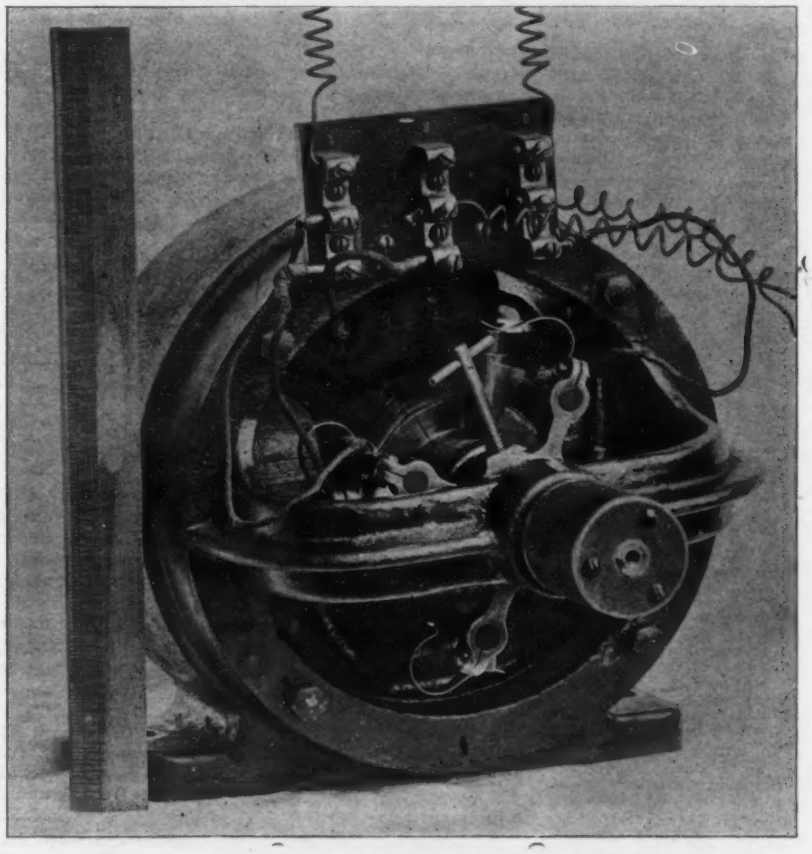


FIG. 1.—250-WATT EXPERIMENTAL DYNAMO.

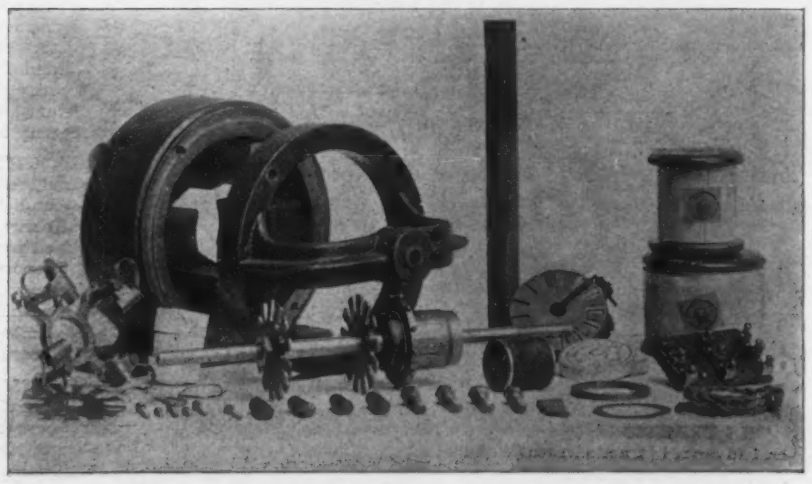


FIG. 2.—STUDENT'S DYNAMO READY FOR WINDING.

. The combined volt- and ampere-meter is for use in experimental work. It is a new design by a competent electrician and mechanician, and is employed for both direct and alternating currents. It is being used in stations and giving satisfaction for all the work it has been put to.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 18, 1896.

AMERICAN BELL continued steady but inactive throughout the whole week, opening at 198 and closing at that figure

GENERAL ELECTRIC opened with a show of strength which disappeared yesterday and closed weak, as it has done for one or two weeks past.

WESTINGHOUSE opened strong on Monday and remained steady all the week. Reports of a falling off in business, necessitating a reduction in wages which resulted in a strike of employees, apparently had no effect upon the stock. A prominent house in Boston is quoted as expressing great faith in the company's future prosperity, and state that all offerings on the Boston exchange are quickly absorbed for the account of Pennsylvania people. The preferred stock has paid 7 per cent. since 1892.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	90	93
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	24½	25¼
Electric Storage, pref	100	25	26
General Electric	100	24¾	25
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	30	30½
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	197	198
American District Telegraph	100	33	40
American Telegraph & Cable	100	90	93½
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	60	60¼
Gold & Stock Telegraph	100	105	..
New England Telephone	100	87	88
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	83	83⅛

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	16¾	16⅞
Binghamton RR. com	100	100	..
Brooklyn Traction	100	5	8
" " pref	100	47	52
Buffalo St. Ry	100	69½	71
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60¾
Columbus St. Ry	100	45	50
Hestonville	100	46	48
Long Island Traction, all pd	100	17¼	18
New Orleans Traction	100	15	17
" " pref	100	62	66
North Shore Traction	100	20	30
" " pref	100	75	80
Rochester St. Ry	..	25	30
Steinway, Ry	..	50	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	10¼	10½
West End, Boston	100	66	66½
" " pref	100	93	..
Worcester Traction	100	14	16
" " pref	100	84	86

BONDS.

Buffalo St. Ry. 1st con. 5s	100	100	103
*Binghamton Railway Co. 5s	100	90	100
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	..	100
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.

THE TRACTIONS.—The latter part of the week has witnessed a very general advance in traction securities, and a better demand appears to exist than or some weeks past.

NEW ORLEANS TRACTION.—The stockholders of the New Orleans Traction Company, at their recent meeting, elected Messrs. Albert Baldwin, J. H. Maury, R. N. Walmsley, C. H. Hyams, F. J. Howard and J. C. Denis, of New Orleans, and J. D. Taggart, of Louisville, directors to serve for the ensuing year. The money which has been earned on the preferred stock will, it is said, be used for improvements instead of being paid out in the form of a dividend. The stock of the company reflects the prevailing uncertainty, and is inclined to be weak. The report of President Maury shows that the indebtedness of the company has been reduced something over $1,000,000, while about $1,100,000 has been expended for construction and material. The company has on hand about $1,100,000 bonds of the Crescent City and City & Lake roads, on which options have been given. Should these bonds be taken the indebtedness would be reduced to about $500,000, and should the collateral trust notes be taken by the New Orleans syndicate the indebtedness would be wiped out.

NORTH SHORE TRACTION, both common and preferred, has advanced, and a fair inquiry exists for both classes of stock. The company, it is said, has signed a contract for a year with its employees, which disposes of any "labor troubles."

BUFFALO RAILWAY stock has been bid up to 80, the highest figure at which it has sold since last November. The advance is attributed to rumors that the decision of the Railway Commissioners, which is expected soon, will be adverse to the new company. The stock declined toward the close to-day on rather free offerings, but continued in demand around 77.

BROOKLYN CITY RAILWAY AND BROOKLYN TRACTION have both scored substantial gains in spite of the fact that a 4-cent fare bill has been introduced in Albany. The latter company and the Nassau people are said to have very nearly agreed upon terms satisfactory to both, and as a consequence Brooklyn Traction common, after selling during the week at 7, advanced to 9½, at which figure sales are reported.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 20, 1896.

THE GEORGE L. COLGATE COMPANY, of 136 Liberty Street, has made an assignment to Percy L. Klock. The company was incorporated in 1894, under New York State laws, with a capital stock of $20,000, and succeeded to the business established a year previously by Mr. Colgate, who continued as president, with James D. McIntosh, treasurer. Mr. Colgate's many friends will join us in the hope that he may pull through all right and continue in business.

THE BUFFALO ELECTRICAL AID ASSOCIATION, Buffalo, N. Y., held its annual meeting and election Monday night. The reports of the officers showed the association to be in a good condition financially and otherwise. The following officers were elected for 1896: President, Madison Buell; vice-president, John Gaul; secretary, George Sallaway; treasurer, William H. Stevens; executive committee, J. G. McNerny, Samuel Stewart, R. B. Ferguson, E. A. Sawken, W. J. Quinn, Miss M. H. Shaw. Miss E. G. Fitzpatrick; auditing committee, William A. Walker, Joseph T. McNerny, James H. NcNally.

THE YOUNG MEN'S INSTITUTE of the Young Men's Christian Association celebrated its eleventh anniversary in the Institute Hall, 222 Bowery, on Tuesday evening, Jan. 14, 1896. The secretary's report showed that during the year over 1000 young men received benefits as members of the Institute, either in the gymnasium or in the evening educational classes. Among the branches taught in the latter are steam engineering, practical electricity and mechanical and free-hand drawing. The total expenses of the year amounted to $11,764. Any young man over 17 and under 35 years of age is entitled, on payment of a fee of $4, to the privileges of the Institute for one year. Further information may be obtained of Dr. D. E. Yarnell, 222 Bowery.

THE NEW YORK BOARD OF ALDERMEN, after several months' consideration, last week voted to leave the Union Railway Company's franchise undisturbed. The Railway Committee investigated the Union or "Huckleberry" Railway all last Fall. The proceedings were based on a petition from citizens to revoke the franchise of the company. A majority of the committee reported against revoking the franchise, but recommended that the company be required to file a bond of $50,000, to guarantee the completion of its lines within two years. The majority report and resolution to compel the Union Railway Company to file a bond of $50.000 to complete its lines within two years were adopted by the Board of Aldermen by a vote of 27 to 4.

THE BROOKLYN RAPID TRANSIT COMPANY filed articles of incorporation on Jan. 18 with the Secretary of State. Its capital is $20,000,000 and it paid as a preliminary State tax, $25,000. The purpose of the company is to "construct, extend, repair and improve railroads" and furnish motive power. The directors are W. C. Bryant, Horace C. Duval, W. W. Goodrich, John D. Kieley, Timothy S. Williams and C. L. Rossiter, of Brooklyn, E. L. Button, W. F. Creed, Frederick S. Flower, Otto Zarker, Jr., Thomas Renwick, Floyd Vail, and James N. Wallace, of New York City. Each director takes one share of stock, the company thus beginning business with $1300. The new company will succeed the Long Island Traction Company in the ownership of the Brooklyn Heights road and in the control of the Brooklyn City and the Suburban companies. Nearly all the directors and incorporators of the Rapid Transit Company are directors in the Traction Company.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Jan. 17, 1896.

THE TELEPHONE EMPLOYEES' MUTUAL BENEFIT ASSOCIATION gave its fifth annual ball at Odd Fellows' Hall on Tuesday evening, Jan 21, the enjoyable occasion being a success in every respect.

AT A MEETING of some of the members of the electrical industry of Boston, at Young's Hotel, on Thursday, Jan. 16, the project of forming an association for the promotion of more harmonious relations among the electrical interests of this city was fully discussed, and a committee to report at an early date was appointed to investigate the subject and ascertain the practicability of such an organization.

MR. GEORGE M. ANGIER, the popular and capable Boston and New England representative of the Eddy Electric Manufacturing Company, and who is well and favorably known throughout the electrical field owing to the prominent positions he has occupied in the industry, was married at Boston, Thursday, Jan. 16, to Miss Emma Gill, a charming and estimable young lady, also of Boston. That the future have nothing in store for Mr. and Mrs. Angier but brightness and the fullness of happiness is the sincere wish of their many friends.

MR. A. ARTHUR ZIEGLER, president of the Ziegler Electric Company, in lighting recently the Christmas tree in his home, to amuse his little son, sustained quite serious injuries in his endeavors to suppress the fire which quickly enveloped the tree and cotton appurtenances. His presence of mind was remarkable, and removing alone the burning tree from the house into the street, it was indeed a miracle that he did not receive worse and even fatal injuries. While the burns are painful and distressing, they are fortunately confined principally to the hands, and with the careful nursing of his good wife, who, by the way, also received slight injuries, it is expected that in a short time Mr. Ziegler will be again at his business desk. As it is, he is able in a great measure to direct from his home the conduct of all important matters pertaining to the business of the Ziegler Company.

HON. JOHN R. MURPHY, Commissioner of Wires for Boston, will soon submit his annual report to the Board of Aldermen, and it is said that it will show very gratifying progress during 1895, in the burial of overhead wires. This, however, is already made manifest in the absence of the masses of overhead wires and poles which have hitherto made hideous so many of the business thoroughfares. During 1895 about 555,000 feet of pipe have been laid, and 898,000 feet of cable drawn in by the West End Railway, Boston Electric Light Company, Edison Illuminating Company, New England Telephone Company, and telegraph and district messenger companies. The Boston Electric Light Company heads the list for amount of work during the year. While Commissioner Murphy and Assistant-Commissioner Brophy have been exceedingly active and have received a number of letters from prominent citizens highly commending them for the efficacious manner in which their duties have been performed, the electrical companies are also entitled to credit for pushing their work so energetically, which will be continued during 1896 with the same earnestness and vigor.

THE NEW ENGLAND ELECTRIC COMPANY, 49 Federal Street, introduces itself to the public this week for "a share of its patronage in electrical supplies of every description." Messrs. Henry Cole, Bracey Curtis, Harry N. West and John S. Keenan comprise the company, and from the business experience and "hustling" qualities of all of them it is quite safe to assume that the new company will command a goodly "share of patronage." All of the gentlemen named, with the exception of Mr. Curtis, are well and favorably known to the electrical trade. Mr. West, from his long connection with the Warren (Ohio) Electric Specialty Company, as New England manager of its incandescent lamp manufactures, and Mr. Cole and Mr. Keenan, from their long identification with the Holtzer-Cabot Electric Company, while all of them can boast of an extended and valuable circle of friends. Mr. Curtis is new in the electrical business, but is of the same kind of material as his associates, and it is only a question of time before he will be thoroughly in "harness." The new company will be central in location, and its store and salesroom will be spacious and attractive.

MR. J. W. DUXBURY, superintendent of the central division of the New England Telegraph & Telephone Company, died at Lowell, Mass., Jan. 13, at the age of 51. Mr. Duxbury was emphatically an old-timer in electrical service. In boyhood during the war he was connected with the army telegraph corps, and away back years ago was in the service of the American Telegraph Company, becoming afterward a sub-chief in the Western Union Company's office at Boston. In the fight between the Western Union and the Bell Telephone Company he took a prominent part, and after the differences had been settled he entered the telephone field, and was for some years superintendent of the Providence (R. I.) Telephone Company. In 1887 he became superintendent of the Western division of the New England Telephone Company, with headquarters at Springfield, Mass., and in 1889 accepted the position of superintendent of the central division with headquarters at Lowell, which position he held with credit up to his death. He connection with the telephone service was continuous for about 17 years, during which time he enjoyed the entire confidence and esteem of his superior officers, associates, subordinates and the public generally. His death is regretted by a large circle of friends.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Jan. 17, 1896.

MR. WILLIAM H. MCKINLOCK, president of the Metropolitan Electric Company, is in the East looking after the interest of the company.

THE TURNER BRASS WORKS is devoting considerable attention to making repair parts for arc lamps. This company, which has a large and well-equipped factory, with every facility for the economical production of special work in brass or kindred metals, reports business exceedingly good.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, of St. Louis, report a good inquiry for their line of specialties, and are especially pleased with orders received and the outlook for business in their new line of Blade Knife Switches. These are extremely well suited for switchboard work and have enabled them to secure several nice orders in this line during the past week.

THE OSBURN ELECTRIC SUPPLY COMPANY, Chicago, is the only manufacturer in the United States of vitrified clay tubes, which are made up to five feet in length. This company is also manufacturing transformers, and handling Warren incandescent lamps. It has a full line of dynamo and motor brushes, both carbon and wire gauze, and is carrying a line of obrosite wires and cables.

THE ELECTRIC STORAGE BATTERY COMPANY, whose Western branch is under the management of Mr. C. W. Woodward, has practically closed a contract for the equipment for the Chicago & Englewood Street Railway Company with 50 storage battery cars, which will be in operation in the Spring. This is the largest storage battery equipment ever purchased by a single corporation in the United States.

THE METROPOLITAN ELECTRIC COMPANY reports that it is still receiving letters of congratulation from all parts of the country on their new mammoth catalogue. This catalogue seems to have taken the electrical trade by storm, and they one and all pronounce it the largest and most complete catalogue that they had the pleasure of receiving. This company reports the business outlook for '96 to be very encouraging.

THE NATIONAL ASSOCIATION OF MANUFACTURERS, which will hold its first annual convention at Chicago, on Jan. 21, has issued its invitations in handsome pamphlet form, comprising also lists of officers, the object of the association, information as to transportation, and the programme of the three days' meetings. The officers of the association include many of the most prominent manufacturers of the United States, the president being Thomas Dolan, of Philadelphia; the treasurer, Robert Laidlaw, of Cincinnati, O.; and the Executive Committee include ex-Senator Warner Miller, T. P. Eagan, Pliny Jewell, and other names almost equally well-known in manufacturing circles.

THE TOLEDO TRACTION COMPANY, of Toledo, O., has just completed the erection of its new power-house at Madison and Water Streets, and is very busy installing the steam electrical machinery. They have just completed and installed a system of underground ducts for the distribution of currents from the new power-house to the business portion of the city. It is expected that the machinery will be in shape to supply currents from the new power-house in about 10 weeks. The new power-house is intended to furnish currents for the three electrical plants at the present being served with power from separate stations—the Consolidated Street Railway Company, the Toledo Electric Company and the Western Electric Company. It is expected by shutting down the above stations and operating the properties from the new power-house, equipped with the most modern electrical machinery, that a large saving in operating expenses will ensue. Messrs. D. H. Burnham & Co. are the architects, and Messrs. Sargent & Lundy, Chicago, the consulting engineers.

THE STANDARD ELECTRIC COMPANY made a voluntary assignment on June 15 for the benefit of all creditors. George M. Stone, one of the attorneys for the company, was named as assignee. D. F. Perry, vice-president and manager of the company, says that the assignment was made because of inability to make collections with which to meet pressing liabilities, although there was ample to pay all creditors, some of whom had threatened to force the company into liquidation. He considers the assignment only a temporary affair, and expects to be ready for business again soon, as there were two or three dollars owing the company for every dollar it owed. Business had been dull for two years, and close competition had hurt the electric business. The company did a business of $250,000 a year. A. G. Spalding, the sporting goods and baseball man, was president until a short time ago, resigning on account of pressure of other affairs. E. E. Cropin is secretary and treasurer, and a heavy stockholder. No statement of assets and liabilities was given out by the company.

CANADIAN NOTES.

MONTREAL, CAN., Jan. 16, 1896.

TORONTO, ONT.—The purchase of an electric light plant for the City Hall is strongly recommended.

ST. THOMAS, ONT.—The negotiations for electrically equipping the railway system are said to be cancelled.

VANCOUVER, B. C.—The construction of an electric tramway from Vancouver to Fort Langley is again talked of.

ATHENS, ONT., is the home of an electric light agitation. If the agitation is big enough, the Athenians will get the light.

OTTAWA, ONT.—An attempt is being made at Ottawa to organize a private telephone service in opposition to the Bell telephone line.

IF ARCHITECT LENNOX has his way Toronto will spend $15,000 in an electric light plant for the new city and county buildings.

THE KINGSTON (ONT.), STREET RAILWAY COMPANY is fitting up its cars with six electric heaters each instead of four, as formerly.

LETTERS PATENT HAVE BEEN ISSUED to the Drummond Electric Company, to supply electric light and power in the town of Drummondville, Que.

HAMILTON, GRIMSBY & BEAMSVILLE RAILWAY.—The question of extending the Hamilton, Grimsby & Beamsville Railway to Beamsville has not yet been settled.

KINGSTON, ONT.—The citizens are talking about civic ownership of the electric light and gas plants. The city solicitor and the mayor are consulting on the subject.

MAYOR LAIDLAW, OF DURHAM, ONT., has been appointed local treasurer and a provisional director of the electric railway which E. A. Pew is so enthusiastically promoting.

AYLMER, QUE.—The Deschenes Electric Company has been incorporated to build and operate works for the distribution of electricity. R. H. and John C. Conroy are among the promoters.

AT THE ANNUAL MEETING of the Hamilton Street Railway Company, the following directors were elected: B. E. Charlton (president), George E. Tuckett, E. Martin, Q. C., W. Gibson, M. P., J. B. Griffith, William Harris and F. W. Fearman.

THE TORONTO, HAMILTON & NIAGARA FALLS ELECTRIC RAILWAY COMPANY has given notice of application for a charter at the next session of Parliament. The personnel of the company is not given, but the C. P. R. is said to be behind the deal.

R. ANDERSON, electrician, of Ottawa, is installing a 600-light plant for John D. McRae, Eganville, Ont., to include about 50 hp in motors and street lights. He is also installing a 100-light plant for the North American Graphite Company, Buckingham, Que., and a 600-light plant for H. Francis Pakenham, Ont., for lighting the mill and village.

THE NEW HEAVY COPPER METALLIC CIRCUIT MONTREAL-TORONTO telephone line is now open for business. The time unit per conversation is three minutes, and the rate from Lincoln, Ont., to Montreal, Que., is $2.60, and 20 cents for each extra minute. Half rates of above between 7 p. m. and 6 a. m. The rate from Toronto to Montreal is $2 for three minutes and $1 from Toronto or Montreal to Kingston.

HULL, QUE.—Mr. Theodore Viau, projector of the electric railway scheme for Hull and Aylmer, has taken over the stock held by the other shareholders, and will at once proceed to form a joint stock company to carry out the work. He has leased a valuable water-power on which to erect the power-house, containing water-wheels and requisite machinery. The first part of his scheme will be the installation of an electric light plant.

AT THE ANNUAL MEETING of the London, Ont., Street Railway, the following directors were chosen for 1896: H. A. Everett, of Cleveland, president; E. W. Moore, Cleveland, vice-president; Charles W. Watson, Cleveland; Thomas H. Smallman, London, and H. F. Holt, Montreal; Charles Currie, formerly assistant, was appointed secretary, vice S. R. Break, and Charles E. A. Carr was re-engaged as manager.

THE INTERNATIONAL ELECTRIC RADIAL RAILWAY is not making much headway at present, the promoter, W. E. Forsyth, being laid up at Buffalo with a broken ankle. A new manager will be appointed, and the company claims that it will shortly be in position to resume progress. The office furnishings in Hamilton were recently seized by the bailiff and sold to satisfy judgments of $150, taken out by the landlord and by M. W. Hopkins, C. E.

General News.

Telegraph and Telephone.

HENDERSON, KY.—Henderson is to have another telephone company.

MARENGO, IA.—A telephone line is projected from Marengo to Belle Plaine.

HOPKINSVILLE, KY.—Hopkinsville is to be connected with Fairview by telephone.

OWENSBORO, KY.—The Owensboro telephone line is soon to be extended to Louisville, via Cloverport.

ROCK HILL, S. C.—A telephone line between this place and Yorkville will be built in the immediate future.

NEW CASTLE, PA.—The two telephone companies here have inaugurated a war of rates, the Bell company cutting the price to $18 a year, as against the new company's rate of $30.

CANTON, O.—A new telephone company has been organized by local capitalists. Edward S. Raff, Charles R. Miller, secretary of the Board of Trade, and Albert Hoeffer, are interested.

DELPHOS, O.—It is understood that a new telephone line is to be constructed between Delphos and Findlay, to pass through Beaver Dam and Bluffton. The line belongs to the system controlled by George W. Beers, of Fort Wayne, Ind.

KEWANEE, ILL.—At the regular meeting of the town board a franchise was granted to Rathborn & Brown, of the People's Telephone Company, to put up and operate a telephone line between Kewanee and Galva and between Kewanee and Cambridge.

MEDINA, N. Y.—Efforts are being made here to introduce the automatic telephone with good prospects of success. If there seems to be a demand for a new exchange, a company will be formed to put in the lines, using the automatic central office switchboard.

OXFORD, PA.—The Octoraro Telephone & Telegraph Company has been granted a charter, and will build telegraph and telephone lines through the counties of Chester, Lancaster and York, running principally along the tracks of the Lancaster, Oxford & Southern Road.

DECORRA, ILL.—Articles of incorporation have been asked by Hon. J. O. Anderson, of Decorra; C. L. Dunsworth, E. H. Allison, F. B. Campbell, L. M. Loomis and J. F. Hains, of Stronghurst, the object being to establish telephone communication through Henderson County.

REDWOOD CITY, CAL.—W. F. Shelley has been granted a permit by the Supervisors to put up poles and wires for a county telephone system to connect with San Francisco. An automatic exchange system will be used. It is expected that work will commence on the new line within 30 days.

YOUNGSTOWN, O.—The Central Union Telephone Company has commenced an open fight against its new competitor by engaging to put 100 telephones into houses of non-subscribers three months free of charge. A big concession in the prices of telephones to old subscribers is now expected.

The Electric Railway.

BARRE, VT.—A movement is now on foot to build an electric road.

BUFFALO, N. Y.—It is probable that the Buffalo Street Railway Company will at once lay tracks on Goodell Street, between Main and Washington

PORT HURON, MICH.—A line between Detroit and Port Huron is the latest probability in this section of the country. George A. Parker of Marine City is one of the chief promoters in the new movement.

PORT JERVIS, N. Y.—Charles D. Haines, of Haines Brothers, who constructed the Newburgh street railway, is a member of a syndicate that is endeavoring to get an electric railway franchise here.

WOBURN, MASS.—The Board of Aldermen has now before it two electric railway petitions, one for the location of the Woburn & Reading Street Railway, and the other for a loop line in connection with the same

BIRMINGHAM, PA.—The Birmingham Street Railway Company held its annual meeting at the office of the Birmingham Traction Company and elected Harry Moore, president, and A. S. Petris, secretary and treasurer.

PITTSFIELD, MASS.—The Pittsfield Electric Railway Company have petitioned for authority to extend its line in and through the town of Dalton, and also for permission to issue stock and bonds to an amount not exceeding $75,000.

MIDDLETOWN, CONN.—The Middletown Street Railway Company, which is controlled by the syndicate that owns the Winchester Avenue system, has completed the purchase of the Portland Street Railway, and the two roads will be consolidated.

PHILADELPHIA, PA.—The Union Traction Company has prepared plans for an extension of the system from the present terminus at Chestnut Hill to the Convent, and for a line running through the private property of John Lowber Welch, to the Bethleham Turnpike.

THE CONSOLIDATED STREET RAILWAY COMPANY, of Grand Rapids, Mich., is building a fine new stack, placing economizers in their boiler room and making many other minor improvements in its station with a view to making its stream plant more economical.

LONG BRANCH, N. J.—At the meeting of the Long Branch Commissioners, permission was granted the Atlantic Coast Electric Railway Company to cross Pond, Cedar, Park, Lincoln and North Lincoln Avenues. The line will probably be extended to Pleasure Bay and possibly to Red Bank.

CATSKILL, N. Y.—The Catskill, Cairo & Windham Street Railway Company has applied for the official consent of the Highway Commissioner of the Town of Catskill to the construction and operation by the company of a single or double track street railway, to be operated by cable or electricity.

RACINE, WIS.—The Milwaukee, Racine & Kenosha Street Railway Company proposes to build and operate a street railway system, to be propelled by electricity or other power, from South Milwaukee, northerly through the village of Cudahy, and the towns of Lake and Oak Creek and the city of Kenosha.

DEFIANCE, O.—The longest electric road in the country will be constructed between Defiance and Fort Wayne. The route contemplated will include the towns of Bryan, Williams, Farmer Center, Hicksville and Maysville. The road will be 60 miles long, and will be built by Eastern capitalists at a cost of $750,000.

LORAIN, O.—At the Council meeting an extension of 90 days was granted on the Mauldin Street Railway franchise, recently purchased by E. K. Mussey, W. G. Sharp, A. L. Garford and H. H. Clough of Elyria. The new company proposes to build an electric railway from Wellington to Lorain, via Oberlin, Elyria, North Amherst and South Amherst, a distance of 30 miles.

QUINCY, MASS.—It is probable that the directors of the Braintree & Weymouth and the Quincy & Boston Street Railways will ask for franchises for roads to connect South Weymouth and Holbrook and Randolph. The first will form a route from Brockton and Bridgewater to Nantasket, and the second will be a loop for the Quincy & Boston and the Brockton, Randolph & Holbrook, and will furnish a route for pleasure traveling besides making communication between neighboring towns easy, and constitute an important link to the proposed cross-country system to Dedham.

Trade and Industrial Notes.

THE ELECTRIC APPLIANCE COMPANY of Chicago is distributing a calendar, unique and artistic in design, containing a moonlight lighting schedule that will be found particularly useful to station managers.

THE IMPERIAL ELECTRIC COMPANY, 213 South Fifth Street, Philadelphia, of which Henry A. Truitt is manager, and the Philadelphia office of the Beacon Lamp Company, of which Mr. Truitt is agent, were removed on Jan. 18 to more commodious quarters at 719 Walnut Street.

FRANK H. STEWART & CO., electrical supply dealers of 35 North Seventh Street, Philadelphia, dissolved partnership by mutual consent on the 14th inst., P. Logan Bockius retiring. The business in future will be conducted by Frank H. Stewart, under the firm name of Frank H. Stewart & Co.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has just completed for the Ansonia Brass & Copper Company, of Ansonia, Conn., a boiler house 65 feet wide and 142 feet long. The side walls are of brick and the roof is entirely steel, covered with anti-condensation corrugated steel.

YES, WE DO JOBBING, is the title of a neat pamphlet issued by the American Tool & Machine Company, 302 Federal Street, Boston, Mass., from which advertising writers may obtain some pointers, and owners and superintendents of factories, mills and workshops information of value in regard to repair work, etc.

XNTRIC SWITCHES AND PAISTE SOCKETS.—Through a printer's error, "Paiste Switches" were advertised in the H. T. Paiste Company's advertisement in our issue of Jan. 11th. The word "Switches" should have read

"Sockets." The Paiste Company's new switch is known as "Xntric" and is not advertised or sold under any other name.

THE FOSTER ENGINEERING COMPANY, of Newark, N. J., has received an order for 11 of its new "Class W" steam-pressure regulators, ranging in size from 1¼ to 4 inches, for the United States Cruiser *Newark*, now at Montevideo. These valves are to take the place of the old styles, furnished the *Newark* when she first went into commission.

THE MERCANTILE TRADE LIST COMPANY, Station A, Pittsburg, Pa., has taken up the question of circular advertising and claims to be solving it to the satisfaction of many business men. This company is constantly collecting and compiling accurate classified lists of those engaged in the various lines of business, making revisions frequently, so that the lists are naturally up to date.

THE AMERICAN CARBON COMPANY, of Nobleville, Ind., have been experimenting in the past year with the object of producing carbons that will surpass anything in shape. of length of life. and purity of light. In this direction it has been very successful, and now claims to be doing the largest carbon business outside of the Trust in the United States, and is securing large contracts

I P. FINCK, 551 Pearl Street, New York, still keeps to the front, and has recently placed his well-known system of reflectors in the following prominent buildings: M. E. Church, Somerset, Ky.; Christian Church, Jackson, Miss.; Baptist Church, Mt. Sterling, Ky.; First M. E. Church, New Orleans, La.; First Baptist Church, Springfield, Mo.; Christian Church, Mishawka, Ind.; First Presbyterian Church, Towanda, Pa.; Baptist Church, Paris, Ill.

STEAM FITTINGS.—The Ashton Valve Company, 271 Franklin Street, Boston, Mass., in a small oblong pamphlet, describes the various Ashton steam fittings, which, during the past 20 years, have become so well known to steam users. Among the appliances described are pop safety valves, water relief valves, steam and vacuum gauges, test and hydraulic gauges, locomotive and marine clocks, and engine registers and counters.

NIGHTINGALE, JOHNSON & CO., 88 Arcade Building, Utica, N. Y., has recently closed a contract for the extension of the wiring at the Middletown, N. Y., Homœopathic Hospital, covering new feeders for the plant already in operation, about two miles of pole-line extension and brass-armored interior conduit for about 300 lights in the building. They have also been awarded a contract for a complete electric light plant at the Rome, N. Y., State Custodial Asylum for 600 lights, most of the wiring for which will be in brass-armored conduits.

WILLIAM W. DONALDSON, 215 North Calvert Street, Baltimore, Md., calls our attention to an error in a statement recently made in these columns to the effect that the first attempt to establish in this country a regular supply of storage batteries for rental for all purposes was made in New York. Mr. Donaldson states that while the company named may have been the first organized for this work, he, as an individual, has carried on that business for two years before the company referred to had started. He first began work in this line in 1890, and shortly afterward had on rental in Baltimore and Washington over 500 batteries on phonographs.

THE STANDARD BOILER COMPANY, of Chicago, report a good business during the past year. They have moved into their new offices, 1120 and 1121 Marquette Building. The boilers handled are built by the Link-Belt Machinery Company, of Chicago, who have recently put in new and improved machinery for their manufacture, thus reducing the prime cost as well as making the various parts interchangeable. During the past year a number of fine plants have been installed, among others being 4000 hp for the North Chicago Street Railway Company, at its new power station on Hawthorn Avenue; 500 hp for the Cincinnati Edison Company; 630 hp for the Western Electric Company, at its factory in Chicago, and various others.

THE GISHOLT MACHINE COMPANY, Madison, Wis., has adopted a system of profit-sharing with its employees, which was put in operation at noon on Dec. 21, and hereafter all employees who have been with the company not less than a calendar year will receive a certain percentage of the profits of the firm, based upon their wages. In 1895 all who had worked for the company 12 months or more received a dividend amounting to 5 per cent. of their wages, the sums ranging from $10 to $40. It has been the desire of Mr. John A. Johnson, the principal owner of the firm, to give his workmen a share in the profits of the company since its incorporation seven or eight years ago, but it was not until last year that the plans could definitely be put into execution.

MAGUIRE & BAUCUS, LIMITED, is a firm that has just been incorporated with a paid-up capital of $250,000. The concern is formed largely for the purpose of export business in electrical apparatus, specialties, etc., and has connections throughout Europe and South America. Messrs. Maguire & Baucus have marketed Mr. Edison's latest invention, the kinetoscope, all over the world, outside of the United States, and are well known in electrical circles. The officers of the company are: Joseph D. Baucus, president; Frank Z. Maguire, vice-president and general manager; Walter B. Howe, treasurer, and William M. Paxton, Jr., secretary. The company is located at 44 Pine Street, New York, and Dashwood House, 9 New Broad Street, London, England.

ART IN ADVERTISING.—One of the handsomest pamphlets ever offered to the electrical trade is that of the Adams-Bagnall Electric Company, Cleveland, O., illustrating and describing their well-known "A-B" arc lamp. In no way is the recent improvement in catalogue work better exemplified than in this pamphlet, which is representative of the latest advances in the arts of typography and engraving. The subject is opened with a well-written history of the arc lamp, accompanied with full-page portraits of Sir Humphrey Davy and Michael Faraday. Various forms of the "A-B" lamps are then taken up and briefly described and illustrated by half-tone engravings, the engravings of some ornamental forms being gilded so as to more perfectly represent the originals.

THE VARIED USES OF ELECTRICITY.—The advance made by electricity since it became a commercial success is well illustrated by a list of the engines now on the order book or under construction at the works of the Ball Engine Company, Erie, Pa., and intended for electric power purposes in some form or other. The different engines are to go to a cotton works, three coal mines, a tin-plate mill, a large lake passenger steamer, a spinning works, two steel works, a shoe factory, a manufactory of mats and rugs, a car works, a knitting works, a hotel, a wood-working plant, a State reformatory, a State insane asylum, an apartment house, two bank buildings, four office buildings, three store buildings; there are besides, engines for electric light and railway power stations. A large proportion of these engines are to be direct-connected to dynamos of standard types.

THE JENNEY ELECTRIC MOTOR COMPANY.—It is reported that Mr. A. K. Hollowell, an Indianapolis capitalist, has purchased a half interest in the Jenney Electric Motor Company, taking the stock held by Messrs. A. A. Barnes, J. F. Pratt and Addison Bybee. Nearly all of the stock, it is said, is now owned by Mr. Hollowell and C. D. Jenney. Mr. Hollowell will at once take control of the financial and general business management of the company, and Mr. Jenney retain charge of the manufacturing department. Mr. Hollowell has been the treasurer and financial manager of Nordyke & Marmon for 20 years. He recently sold his stock in that concern to Mr. Marmon. For 10 years he was interested in the electric department of this company's business, so that he goes into the Jenney Company with a valuable experience. The Jenney Company has recently moved into its new factory, where 75 men are employed, and room for more is already needed. The works are in operation day and night, and the company is running to its full capacity to fill current orders.

AN EFFICIENT GAS ENGINE.—Jacob Brombacher's Sons, 30 Cliff Street, New York, in a circular call attention to the simplicity of design, close regulation and high efficiency of their "Climax" gas engines. The makers claim to conduct their business on a radically different basis from the manner in which gas-engine business has heretofore generally been done, selling their engines with certificates showing the brake horse-power capacity as determined by actual test in each case, and giving guarantees as to gas consumption. At full load it is guaranteed that the engines will deliver a brake horse-power at a cost of 2 cents per actual horse-power-hour, based on gas costing $1.25 per 1000 feet, and that every single cylinder engine will light at a cost of .3 cent per 16 cp lamp hour, or at ¼ of a cent per hour from the twin cylinder type of engine. The Keystone Electric Company, of Erie, Pa., in a letter to the makers, state that in a recent test of the "Climax" gas engine belted to a dynamo the regulation was within 1 per cent. under the usual varying conditions of load.

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

THE ELECTRICAL COLLECTION AGENCY, recently established at Birmingham, Ala., for the exclusive use of electrical manufacturers and supply dealers, will be welcomed by the trade. Much money has been lost in the South by the credit system being too liberally applied, and the object of the new agency is to protect the manufacturers and the trade generally. It is managed by a gentleman whose 14 years' connection with the Southern trade, coupled with the best of references, assures the accomplishment of its object.

Illustrated Record of Electrical Patents.

UNITED STATES PATENT ISSUED JAN. 14, 1896.

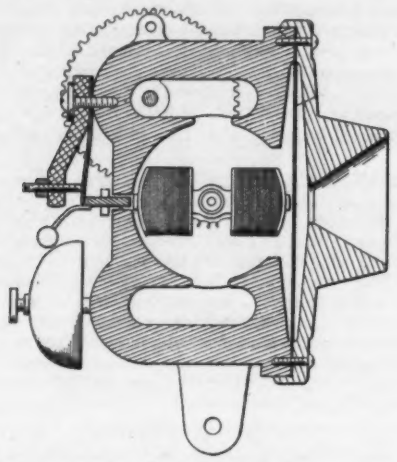
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

552,734. TELEPHONE SWITCHBOARD AND CIRCUIT; T. C. Wales, Jr.' Boston, Mass. App. filed July 25, 1895. The combination of a signaling circuit and a conversation circuit; with a switching relay as described having two coils of different resistance, and a circuit-closing armature, the coil of least resistance being a grounded end of the signaling circuit with a resetting annunciator and battery, the high-resistance coil being in a circuit having one end opened in a switch in said conversation circuit, the other end being grounded through the said battery; and means for closing the circuit including the high-resistance coil and battery consisting of a cord plug having a third conductor to the ground through a resistance. (Issued Jan. 7, 1896.)

552,897. MESSENGER CALL SYSTEM FOR BUILDINGS; H. Denver, Springfield, Mass. App. filed June 24, 1893. A messenger call system for buildings consisting of the combination with a call box conveniently located with respect to a certain number of rooms, said call box being electrically connected with the central station of an indicator located adjacent to said call box and adapted to be set to indicate either of said rooms.

552,924. ELECTRIC RELEASING DEVICE; S. H. Reynolds, San Jose, Cal. App. filed March 13, 1895. In a releasing device, the combination of a casing, a bolt movably mounted therein, a latch having engagements with said bolt and arranged to move the same into operative position when actuated, an electromagnet, an armature for the same arranged to engage said latch and hold the same against movement when the latch is actuated to move said bolt into operative position, said armature being adapted when moved by said magnet to release said latch, and means for moving the bolt out of operative position when said latch is released.

552,933. ELECTRIC BELL; C. B. Sterling, New York, N. Y. App. filed Sept. 3, 1895. The combination with the gong, the solenoid and the vertical movable core in the solenoid, of a circuit maker and breaker connected to the lower end of said core, stationary contacts insulated from each other to engage the circuit maker and breaker, guides for the circuit maker and breaker, electrical connections between the supply conductors and the contacts, and a rotary break engaging the core.



No. 552,972.—Telephonic Apparatus.

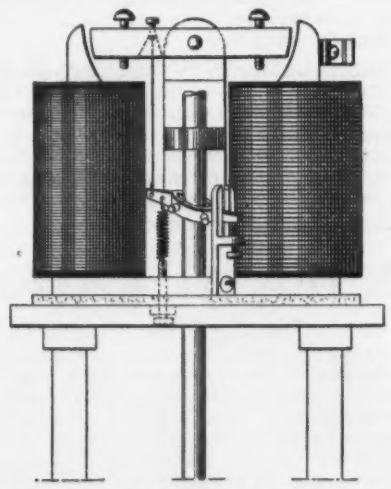
552,954. AUTOMATIC ELECTRIC RELEASING DEVICE; J W. Chute, San Jose, Cal. App. filed April 16, 1895. In a releasing device, a fulcrumed spring-actuated swinging arm, a spring-actuated latch adapted to engage the arm and retain it in engagement, a spring-actuated bell-crank lever fulcrumed with relation to the latching lever so as to strike and disengage it when released, and a catch by which said lever is normally retained out of contact or engagement with the latch.

552,961. ELECTRIC MOTOR; D. C. Jackson and C. M. Conradson, Madison, Wis. App. filed July 26, 1895. In combination with a hub having threaded openings at each end; a bearing sleeve provided with circumferential curved flanges and the threaded collars screwing into the hub and having curved faces to engage the flanges.

552,967. ELECTRIC ARC LAMP; L. G. Nilson, Sioux City, Ia. App. filed July 25, 1893. In an arc lamp, the combination of a main and shunt magnet, a back yoke connecting the cores to the same, a post connected to said back yoke, and a single armature common to both magnets pivoted to said post, the said post forming a part of the magnetic circuit of both magnets.

552,972. TELEPHONIC APPARATUS; C. J. Schwartze, Adrian, Mich. App. filed April 22, 1895. The combination with the permanent magnet and revolving armature of a generator organized for the production of currents for signaling, of a diaphragm forming a vibrating pole of said permanent magnet and constituting with the armature and the other pole the elements of a telephonic transmitter.

552,982. ELECTRIC ARC LAMP; F. J. Borland, Leeds, Eng. App. filed Aug. 17, 1894. The combination with a support, a shunt coil, and a series coil secured to the said support, a tubular spindle passing through said coils, and a central core slidable in the said spindle; of the lower lever pivoted to the said support, and having its rear end operatively connected with the said core, the upper lever also pivoted to the said support, and the toothed intergearing segments secured to the respective levers.



No. 552,967.—Electric Arc Lamp.

553,014. ELECTRIC CIRCUIT CONNECTOR; T. F. Nevins, Brooklyn, N. Y. App. filed May 16, 1895. The combination with the casing containing a rotatable ratchet-toothed cut-out block, provided with a central socket and having contact pieces extending from opposite points in the socket to opposite points on the teeth, and spring contacts connected with the leading-in wires of a conductor having a plug provided with diametrically opposite contact strips, and adapted to be inserted into said socket, means for preventing the direct removal of the connector from the casing when an electrical connection is made, and conducting wires secured to the connector, and connected to the contact strip.

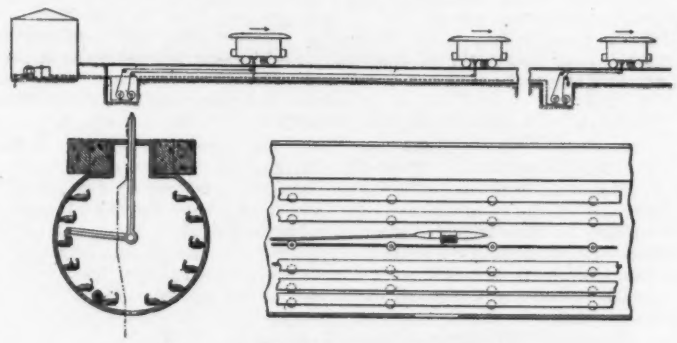
553,022. MOTOR TRUCK; L. Warfield, Detroit, Mich. App. filed Nov. 18, 1891. The combination, with a truck frame of an electric motor supported entirely from the frame, an axle journaled in said frame, a gear wheel having a grooved hub secured on the axles so as to turn therewith while free to move longitudinally thereon, an arm secured to the truck frame and having a flange or finger arranged to engage with the groove in the hub of the gear wheel and keep it in a fixed position relatively to the motor frame, and a suitable gear actuated by the motor meshing with the gear wheel.

554,058. STREET INDICATOR; C. Eby, Rocky River, O. App. filed Aug. 28, 1895. The combination, with the trolley wire, motor-car, trolley pole and street name bearing belt, of the electric motor arranged within an electric circuit and operatively connected with the aforesaid belt, the toothed wheel, pawls, armatures, spring, magnet having one of its terminals electrically connected with one of the terminals of the motor, contact suitably supported from the trolley-pole and electrically connected with the other terminal of the magnet and stationary contact electrically connected with the trolley wire, all arranged and operating substantially as shown.

553,061. TROLLEY CUT-OUT; T. Fletcher, Idlewild, Tex. App. filed March 28, 1895. A trolley cut-out, provided with a hanger comprising side pieces, and a centre piece coupled with the heads of the side pieces and formed with openings in the bottom, to permit the heads to drop out of the centre pieces, the heads of the side pieces being segmental ribs at the end to engage in segmental grooves in the centre piece.

553,099. BONDING DEVICE FOR ELECTRIC RAILWAYS; W. Brown, Camden, N. J. App. filed May 25, 1895. A bond terminal having a screw-threaded opening, lengthwise slotted, and means to enter and expand the said opening.

553,106. AUTOMATIC CLOSING TELEGRAPHIC KEY; J. A. Coleman, Perry Station, Canada. Nov. 13, 1895. In a telegraphic key the combination of the key-lever, a button comprising two sections, one section connected to the key lever and the other movably connected to the stationary section, a pin projecting from the movable section in the same plane as the key lever, a jointed lever pivotally connected to the key lever, a contact point carried by the jointed lever, a connection between the pin and the jointed lever, whereby the contact point is moved by the movement of the movable section.



No. 553,176.—Electric Railway.

553,176. ELECTRIC RAILWAY; T. F. O'Connor, New York, N. Y. App. filed April 2, 1894. In an electric railway, the combination with a suitable way, of a motor vehicle, a slotted conduit extending parallel with the way, an electric conductor having one end stationary and connected with a source of power, and a conducting arm carried by the motor vehicle and traveling in the slot and to which the electric conductor is connected within the conduit.

553,179. TELEPHONE CIRCUIT; E. Slade and J. S. Stone, Boston, Mass. App. filed July 12, 1895. The combination of a telephone exchange circuit extending between a substation and a central station, and serving for the transmission of both signals and conversation; a signaling current generator normally in circuit therewith; and a transmitter current generator adapted for connection therewith during the transmission of speech; with a switching device, such as a plug, controlling terminals of said transmitter current generator and adapted to connect the same with said exchange circuit and subsequently to disconnect the signaling generator therefrom.

553,194. CLIP FOR SUPPORTING ELECTRIC CABLES; R. H. Lewis, Providence, R. I. App. filed Oct. 30, 1895. In a clip, the combination with the blank having at one end the tongue, and near the other end the opening of the holes and the double hook constructed to support the cable and automatically adjust itself to the cable.

553,198. AUTOMATIC LIGHTING OR EXTINGUISHING APPARATUS; S. C. Stickle, New York, N. Y. App. filed May 10, 1895. The combination of a main or lighting circuit, a main circuit device included therein, a circuit having a circuit-closer and an electromagnet of the main circuit-closing device included therein, adapted to close the main or lighting circuit, a circuit likewise having a circuit-closer and an electromagnet of the main circuit-closing device included therein adapted to open said main or lighting circuit, and clock mechanism for operating the circuit-closer aforesaid, and cause the same to make and break their respective circuits.

553,220. ELECTRIC LAMP SUPPORT; J. Buckner, Boston, Mass. App. filed June 10, 1895. An electric lamp support comprising a metal post having a fixed collar near its upper end, a tubular insulator supported by said collar and having an outwardly projecting flange, a sectional metal sleeve clamped upon said insulator, and the lamp arms or standards secured to said sleeve.